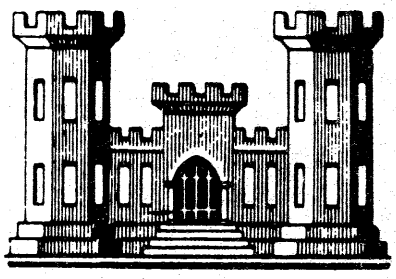
WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER DAM

CHARLES RIVER BASIN, MASSACHUSETTS

DESIGN MEMORANDUM NO. 2

GENERAL DESIGN, SITE GEOLOGY AND RELOCATIONS



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FEBRUARY 1972

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED-E 14 February 1972

SUBJECT: Charles River Dam, Boston, Massachusetts, Design Memorandum No. 2, General Design, Site Geology and Relocations

HQDA (DAEN-CWE)
WASH DC 20314

1. In accordance with ER 1110-2-1150 dated 19 June 1970, there is submitted for review and approval Design Memorandum No. 2, General Design, Site Geology and Relocations, for the Charles River Dam Project. The memorandum includes both Phase I and Phase II owing to the advanced stage of completion at the time of receipt of new ER 1110-2-1150 dated 1 October 1971.

2. Basic planning and engineering studies for the recommended project were accomplished in the year 1964 by Charles A. Maguire and Associates, Inc., Consulting Engineers for the Metropolitan District Commission, Commonwealth of Massachusetts. Feature design memoranda, including updated and revised data to meet Corps criteria, are currently being prepared by Charles A. Maguire and Associates, Inc. under contract to this Division.

3. This memorandum reflects modifications and changes to the authorized project plans developed during updating and preparation of feature design memoranda. A description of departures and the reason for changes are outlined in the text of the report.

4. All elevations shown in this Memorandum are based on Metropolitan District Commission (MDC) Datum which is 105.65 feet below mean sea level.

NEDED-E 14 February 1972

SUBJECT: Charles River Dam, Boston, Massachusetts, Design Memorandum No. 2, General Design, Site Geology and Relocations

5. Formal assurances of non-Federal cooperation and participation and local cash contributions will be acquired subsequent to approval of the General Design Memorandum.

6. It is recommended that the multiple-purpose project plan for flood control, navigation and highway transportation be approved as a basis for completion of feature Design Memoranda and preparation of contract plans and specifications. The recommended improvements and schedule for submission of feature Design Memoranda and plans and specifications for review and approval were discussed with OCE representatives in meeting held in this office on 31 January 1972. It is further recommended that the procurement of pumps and associated equipment by separate Government supply contract be approved.

FOR THE DIVISION ENGINEER:

Incl (14 cys)
as

JOHN WM. LESLIE
Chief, Engineering Division

Encl 2

DAEN-CWE-B (NEDED-E, 14 February 1972) 1st Ind
SUBJECT: Charles River Dam, Boston, Massachusetts, Design Memorandum No. 2, General Design, Site Geology and Relocations

DA, Office of the Chief of Engineers, Washington, D.C. 20314 13 March 1972

TO: Division Engineer, New England
ATTN: NEDED-E

1. Approved, subject to the following comments.

2. Section A - Pertinent Data and Paragraphs 36 and 48. The width of the small locks is 22 feet rather than 25 feet because of the 18-inch space occupied on each side by the floating mooring fenders.

3. Paragraphs 3 and 8. The requirements for local cooperation should include provisions relative to compliance with Public Law 91-646 and Section 221 of Public Law 91-611.

4. Paragraphs 3k and 109 and Appendix B, Paragraph 9b. Local interests should be required to pay 50 percent of the cost of the structural features allocated to navigation and 100 percent of the structural features allocated to highway transportation rather than 18.3 percent of the total first cost of the structural features of the project. Accordingly, appropriate changes should be made in the subject general design memorandum.

5. Paragraphs 25, 26, 88 and 93a and Appendix C. Further study of the water quality and fishery aspects of the project is warranted. It may be feasible to develop a salt water barrier (a field of water or air jets) at the abandoned lock. This would provide an entirely fresh-water basin above the existing dam and allow the establishment of a high value resident and put-and-take sport fishery. It would allow deletion of fish passage facilities and salinity control facilities such as sluices and lock pumps at the proposed dam. The Hydraulics Division, Waterways Experiment Station, should be contacted for a feasibility analysis of the suggested salt water barrier as well as review of the efficiency of the proposed salinity control measures.

6. Paragraphs 41 and 89, Plates 2-2, 2-3 and 2-7, and Appendix G. Sufficient information is not presented to evaluate the adequacy of the fish passage facilities. As it would often be necessary to transfer operations four times a day between the fish ladder and fish lock with attendant delays to fish passage while the fish become accommodated to new entrance conditions, consideration should be given to providing only a lockage system. Additional information and discussion on these aspects are requested.

DAEN-CWE-B (NEDED-E, 14 February 1972) 1st Ind 13 March 1972
SUBJECT: Charles River Dam, Boston, Massachusetts, Design Memorandum No. 2, General Design, Site Geology and Relocations

7. Paragraph 45b. Pneumatic diaphragm piezometers or Casagrande-type piezometers with one-half inch diameter riser tubes should be used instead of electrical transducer piezometers. The latter are more complex and less dependable than the other types.

8. Paragraph 58. The architectural treatment of the pumping station, control tower and personnel building should conform to that approved in the current separate correspondence.

9. Paragraph 70. The type of land, under the description pile and platform and river flats, is not clear. Also, it is not discernible whether the navigational servitude is attached to any of the filled land. To the extent that any of the proposed improvements are in navigable water, construction should be based on the exercise of the navigational servitude and consideration should be given to require local interests to secure a permit to maintain the highway viaduct within the navigational servitude, if applicable.

10. Paragraph 73i. Railroad relocations, covering a section of the Boston and Maine Railroad, do not include any railroad bridges and appear to be an obligation of local interests under the requirements of local cooperation as set forth in paragraph 3c.

11. Paragraph 77. Paragraph 48 (last paragraph on page 32) reveals that the optimum plan for alleviating the existing and prospective navigation difficulties would be to abandon the existing lock and provide new and larger locking facilities. However, there is no mention of what is to happen to the existing lock. If the existing lock is to be left intact, a statement should be included in paragraph 48 which explains its function and if the existing lock is to be removed, a sentence should be furnished in paragraph 77 which indicates the time of removal; also, the cost of this removal should be indicated in the detailed cost estimate.

12. Plates 2-3, 2-6, et al. The view of eastbound traffic nearing the locks appears to be rather seriously impaired by the viaduct superstructure. This should be studied to ascertain whether sight conditions are acceptable.

13. Plates 2-5 and 2-6. It appears that filling and emptying culverts around the sector gates with sluice gates for valves are to be provided. The need for, and arrangement of these culverts appear questionable, as filling and emptying will be accomplished part of the time by pumping and can be accomplished the remaining portion of the time by the sector gates.

DAEN-CWE-B (NEDED-E, 14 February 1972) 1st Ind 13 March 1972
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It is requested that a sufficient number of drawings and descriptive material be furnished to permit an understanding of the design and function of the filling systems for the navigation locks.

14. Plate 2-6.

a. Concrete Note No. 7. A table of bar laps for various diameters should be furnished since the 30-diameter laps for all bars is in error.

b. Concrete Note No. 9. The degree of restraint of members should be considered in designing reinforcement in accordance with EM 1110-2-2103. (See OCE trip report, 22 February 1972, 31 January - 1 February 1972 meeting in NED.)

c. Structural Steel No. 1. ASTM Specification A242 should be deleted due to lack of chemistry control.

15. Paragraph 6, Basic Letter and Paragraph 110. A statement should be furnished on the status of the contract between the Metropolitan District Commission and Fairbanks Morse and how the procurement of the pumping equipment for the subject project is to be handled.

FOR THE CHIEF OF ENGINEERS:

Incl
wd

for JOSEPH M. CALDWELL
Chief, Engineering Division
Directorate of Civil Works

NEDED-E (14 Feb 72) 2nd Ind
SUBJECT: Charles River Dam, Boston, Massachusetts, DM No. 2, General Design, Site Geology and Relocations

DA, NED, CE, Waltham, Mass. 02154 1 May 1972

TO: HQDA (DAEN-CWE-B), WASH DC 20314

1. The following information and comments are referenced to the same paragraph numbers as the 1st Indorsement.

2. The clear distance between the small navigation lock concrete walls of 25 feet is reduced to a 22-foot navigation opening by the floating mooring fenders.

3. Local cooperation assurances for the project have included provision of Public Law 91-646. Pursuant to Section 221 of Public Law 91-611, construction of this project will not commence until assurances between the Commonwealth of Massachusetts and the Secretary of the Army are executed.

4. The 18.3 percent figure has been deleted from the local assurance document. Revised pages for the GDM are forwarded to reflect the correct wording and deletions for paragraphs 3k, 109 and Appendix B, paragraph 9c.

5. The Fish and Wildlife Service of the Department of the Interior furnished the following information for the comments in paragraphs 5 and 6. An active joint Federal-State program is under way to restore anadromous fish to the lower 60 miles of the Charles River. As part of the restoration program, fish passage facilities have been reconstructed (for a cost of $45,000) at the next dam upstream from the existing Charles River Dam. Planning is under way to provide fish passage at 9 additional upstream dams. The elimination of salt water between the proposed and existing Charles River Dam will enhance the achievement of this restoration program and improve the resident fishery. These programs do not preclude the need for anadromous fish passage facilities at the proposed project.

6. The transfer of operation from fish ladder to fish lock and vice versa will pose no problem or delays. These structures are only 4 feet apart with identical entrance geometry and flow conditions. The entrance jets for both the fish ladder and fish lock will have a velocity range of 3 to 8 fps regulated by telescopic entrance weirs.

The fish ladder would operate by gravity flow when the tide level is below El. 108 MDC Datum. The fish lock would supply necessary attraction during this period. The fish lock would operate when the tide level is above El. 108 at which time the fish ladder would be closed. Both facilities could operate simultaneously when the tide is between El. 106 and El. 108. Modifying the fish passage facilities to providing only the fish lock has a disadvantage in that the upstream migrants are excited and stressed in the lock due to crowding and sluicing operations. This is not the case in a fish ladder operation. The fish ladder also provides considerable opportunity for public viewing of anadromous fish migrating upstream over the fishway weirs. A fish lock is a mechanical device with higher O & M costs and lower reliability when compared to a fishway.

7. Pneumatic diaphragm piezometers will be utilized for the project.

8. Architectural treatment of the pumping station will be the subject of several concept presentations to develop the most appropriate design. The control tower and personnel building will conform to the revised pump station architecture.

9. The description of the pile and platform river flats apply to Parcels 1, 4 thru 7 and 8. All parcels to be acquired are limited to areas within the United States Pierhead and Bulkhead Line which is the limit of the existing navigational servitude. The existing navigation channel, delineated by the ruins of the former Warren Avenue bridge, will be preserved by construction of the lock facilities. The Metropolitan District Commission will be advised of the permit requirements to maintain the highway viaduct.

10. Railroad relocations outlined in paragraph 73i are included in the non-Federal relocation costs of $7,100,000 (See Table B-4, Page B-7, Appendix B).

11. The existing lock structure will remain intact with the lock gates fixed in the permanently open position. Navigation improvements cannot be realized by removing the existing structure due to limitations imposed by existing buildings on the dam and highway bridge crossing.

12. Studies were made for sight conditions under the viaduct from various horizontal locations in the control tower. These studies indicated that shipping is visible upstream from the control tower, a distance of approximately 800 feet. Additional sight distance will be obtained by revision to the vertical alignment of the control tower or the viaduct.

13. The lock filling and emptying system was designed to minimize the intrusion of salt water into the basin, conserve the fresh water of the basin and to aid in the evacuation of the saline wedge from the basin. During lock filling by gravity from the basin, flow into the lock culvert system will be limited to the dense saline wedge at the bottom of the basin by means of skimmer walls installed on the fender system surrounding the culvert intakes. The basis for this design is a report entitled "Salinity Intrusion Problems in the Proposed Mystic River Basin" by Donald R. F. Harleman, September 1962, which refers to model studies on the flow of salt water from a lock into fresh water. (A copy of this report was furnished on a loan basis to Mr. J. Davis (DAEN-CWE-Y). These tests were reported in "An Experimental Study of the Motion of Saline Water from Locks into Fresh Water Channels", National Bureau of Standards Report 5168, March 1957, by G. H. Keulegan.

14. This office concurs with the structural recommendations which will be utilized in the preparation of contract plans and specifications.

15. The Metropolitan District Commission has a previously bid contract with Fairbanks Morse to supply 6 pumps for the Charles River project and 3 pumps for their own Mystic River project. The MDC plans to amend this contract to procure only 3 pumps for the Mystic project. For maintenance and operation advantages, the MDC wishes to have the same equipment for the Charles River project. Fairbanks Morse has completed the pump model tests, test report preparation and engineering drawings. Negotiating a new contract with Fairbanks Morse will result in a saving of time

NEDED-E (14 Feb 72) 2nd Ind
SUBJECT: Charles River Dam, Boston, Massachusetts, DM No. 2, General Design, Site Geology and Relocations

and money to the Government. A set of specifications and drawings were forwarded for review at the same time that documents were forwarded to Fairbanks Morse with a request for a proposal.

FOR THE DIVISION ENGINEER:

Incl (in dupe)
as

for JOHN WM. LESLIE
Chief, Engineering Division

Engr

DAEN-CWE-B (NEDED-E, 14 Feb 72) 3rd Ind
SUBJECT: Charles River Dam, Boston, Massachusetts, Design Memorandum No. 2, General Design, Site Geology and Relocations

DA, Office of the Chief of Engineers, Washington, D.C. 20314 29 June 1972

TO: Division Engineer, New England, ATTN: NEDED-E

1. Reference DF DAEN-CWE-E, 4 May 1972, subject: "Trip Report - Charles River Dam, Boston, Mass.," copy previously furnished.

2. The information furnished and the actions indicated in the 2nd indorsement are satisfactory, subject to complying with the agreements reached in the 20-21 April 1972 meeting reported in the referenced DF and to the comments contained in the following paragraphs.

3. 2nd indorsement.

a. Paragraph 5 and paragraph 4d(5) of referenced DF. A detailed study and report on salinity intrusion and provisions for its control is required. A plan of study, including definition of objectives, should be prepared and submitted for review and approval. A comprehensive study resulting in an effective design for the control of salinity intrusion is considered to be essential, based on continuing problems concerning saltwater intrusion through the Hiram M. Chittenden Locks on the Lake Washington Ship Canal, Seattle, Washington. A report prepared by the Committee on Tidal Hydraulics on the problem at the Chittenden Locks is attached for your information as Inclosure No. 3.

b. Paragraph 6. During detailed studies of fish passage facilities, consideration should be given to using a fishlock or a bucket facility similar to the one used at the Foster Reservoir project on the South Santiam River, Oregon (Portland District).

FOR THE CHIEF OF ENGINEERS:

C. E. Stanton
for JOSEPH M. CALDWELL
Chief, Engineering Division
Directorate of Civil Works

1 Incl
2. wd
Added 1 Incl
3. as

NEDED-E (14 Feb 72) 4th Ind
SUBJECT: Charles River Dam, Boston, Massachusetts, DM No. 2, General Design, Site Geology and Relocations

DA, NED, CE, Waltham, Mass. 02154 29 August 1972

TO: HQDA (DAEN-CWE-B), WASH DC 20314

1. Discussion with the U. S. Fish and Wildlife Service indicated that elimination of salt water intrusion was not a prerequisite for the anadromous fish program and any reduction in salinity from the present condition would be beneficial. It is not intended to create a fresh water resident fishery in the basin but to re-establish a run of anadromous fish to the lower reach of the river.

2. This project as designed will substantially reduce the salt water intrusion into the basin from the proposed dam, and aid in the evacuation of the lower saline wedge. If it were our intent to completely eliminate salt water intrusion into the basin, we would agree that a detailed study of salinity control would be necessary based on problems experienced at other locations. Mr. J. Doumas, OCE, and Mr. S. Cooper, NED, informally discussed this subject. It was not considered necessary to prepare a detailed study and report for salt water intrusion since the project will only minimize rather than completely eliminate salt water intrusion into the Charles River basin.

3. Salt water intrusion will be reduced by the following means:

a. The new dam embankment will be designed and constructed to yield minimum leakage for the low differential head conditions encountered. Lock sector gates will be designed with appropriate seals to reduce leakage.

b. Each day when the tide is below the basin, the normal fresh water flow will be discharged to the ocean through the low level sluice located at the north side of the pumping station. The heavier saline water at the bottom of the basin therefore will be released during these operations.

c. Lock chambers will always be discharged to the ocean either by gravity when tide level permits or by pumping when the tide is high. Filling the lock chambers by gravity from the river basin will be limited to the saline wedge at the bottom of the basin by means of skimmer walls installed on the fender system surrounding the lock culvert intakes.

NEDED-E (14 Feb 72) 4th Ind 29 August 1972
SUBJECT: Charles River Dam, Boston, Massachusetts, DM No. 2, General Design, Site Geology and Relocations

4. Review of the suggested bucket facility similar to the Foster Reservoir project indicated that it is not appropriate for this project. Additional input for the fish passage facilities will be in accordance with agreements reached at the OCE meeting held on 28 July 1972 (Ref: trip report dated 9 August 1972, copy attached). It is currently planned to discuss the fish passage facilities with the North Pacific Division Hydraulic Laboratory.

FOR THE DIVISION ENGINEER:

JOHN Wm. LESLIE
Chief, Engineering Division

1 Incl
3. wd
Added 1 incl
4. as

Engr

DAEN-CWE-B (NEDED-E, 14 Feb 72) 5th Ind
SUBJECT: Charles River Dam, Boston, Massachusetts, Design Memorandum No. 2, General Design, Site Geology and Relocations

DA, Office of the Chief of Engineers, Washington, D.C. 20314 24 October 1972

TO: Division Engineer, New England, ATTN: NEDED-E

1. The actions indicated and the information furnished in the 4th indorsement and inclosure thereto are satisfactory, subject to the comments furnished in the following paragraphs.

2. It is stated in paragraph 1 of the 4th indorsement that the U. S. Fish and Wildlife Service indicates any reduction in salinity from the present condition would be beneficial; however, the magnitude of the potential benefits has not been revealed. It is also stated that a reduction in salinity is not a prerequisite to the anadromous fish passage and they do not intend to create a fresh water fishery; therefore, the need of any provision for reduction in salinity in relation to the aims and purposes of the U. S. Fish and Wildlife Service is not understood. It appears that before constructing provisions, such as for pumping lock water into the harbor, definite needs and quantified objectives for salinity reduction should be established. If no needs are identified, no construction or operation and maintenance costs pertaining to salinity reduction should be entailed.

3. Paragraph 4, 4th indorsement and Inclosure No. 4. The agreements noted in paragraph 4c of the 4th indorsement could be misleading in regard to the status of review and approval of the fish passage provisions by OCE. It should be noted that the material examined at the meeting was very preliminary and that there were no hydraulic design analysis as to overall performance requirements such as water surface levels, velocities, discharges, flow patterns, size of passages, pumping requirements, sequencing of operations, and other closely related hydraulic design aspects.

4. Drawings and hydraulic design analysis and/or results of model testing should be presented in sufficient detail for review and approval of this feature in OCE.

FOR THE CHIEF OF ENGINEERS:

1 Incl
wd

for JOSEPH M. CALDWELL
Chief, Engineering Division
Directorate of Civil Works

NEDED-E (14 Feb 72) 6th Ind
SUBJECT: Charles River Dam, Boston, Massachusetts, Design Memorandum No. 2, General Design, Site Geology and Relocations

DA, NED, CE, Waltham, Mass. 02154 8 January 1973

TO: HQDA (DAEN-CWE-B), WASH DC 20314

1. Specific objectives for reduction of basin salinity intrusion for this project cannot be identified other than a desire by the sponsoring agency (Metropolitan District Commission) to maintain a nearly freshwater basin for aesthetic considerations. Cost comparisons between the requirements for navigation lock and pumping station dewatering system versus the navigation lock operating pumping system indicates an added cost for navigation lock pumping of approximately $12,000. This added cost will be applied to the non-Federal costs of the project since the MDC wishes to retain the lock pumping system as designed.

2. Fish passage facilities are being redesigned to a vertical slot type passage operable under all tidal conditions as recommended by the North Pacific Division Hydraulic Laboratory. It is planned to conduct a model test of this redesigned facility and the test results will be forwarded for review.

FOR THE DIVISION ENGINEER:

JOHN Wm. LESLIE
Chief, Engineering Division

DAEN-CWE-B (NEDED-E, 14 Feb 72) 7th Ind
SUBJECT: Charles River Dam, Boston, Massachusetts, Design Memorandum No. 2, General Design, Site Geology and Relocations

DA, Office of the Chief of Engineers, Washington, D.C. 20314 1 March 1973.

TO: Division Engineer, New England, ATTN: NEDED-E

The actions indicated and the information furnished in the 6th indorsement are satisfactory.

FOR THE CHIEF OF ENGINEERS:

for R. J. Harrington
JOSEPH M. CALDWELL
Chief, Engineering Division
Directorate of Civil Works

DAEN-CWE-B (NEDED-E, 14 February 1972) 1st Ind
SUBJECT: Charles River Dam, Boston, Massachusetts, Design Memorandum No. 2, General Design, Site Geology and Relocations

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for JOSEPH M. CALDWELL
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424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

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FOR THE DIVISION ENGINEER:

Incl (14 cys)
as

JOHN WM. LESLIE
Chief, Engineering Division

WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER DAM
CHARLES RIVER BASIN
MASSACHUSETTS

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3	Concrete Materials		19 Feb 71	29 Mar 71
4	Embankments and Foundations	Feb 72		
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7	Navigation Locks and Facilities	Mar 72		
8	Cofferdams	May 72		

WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER DAM

CHARLES RIVER BASIN

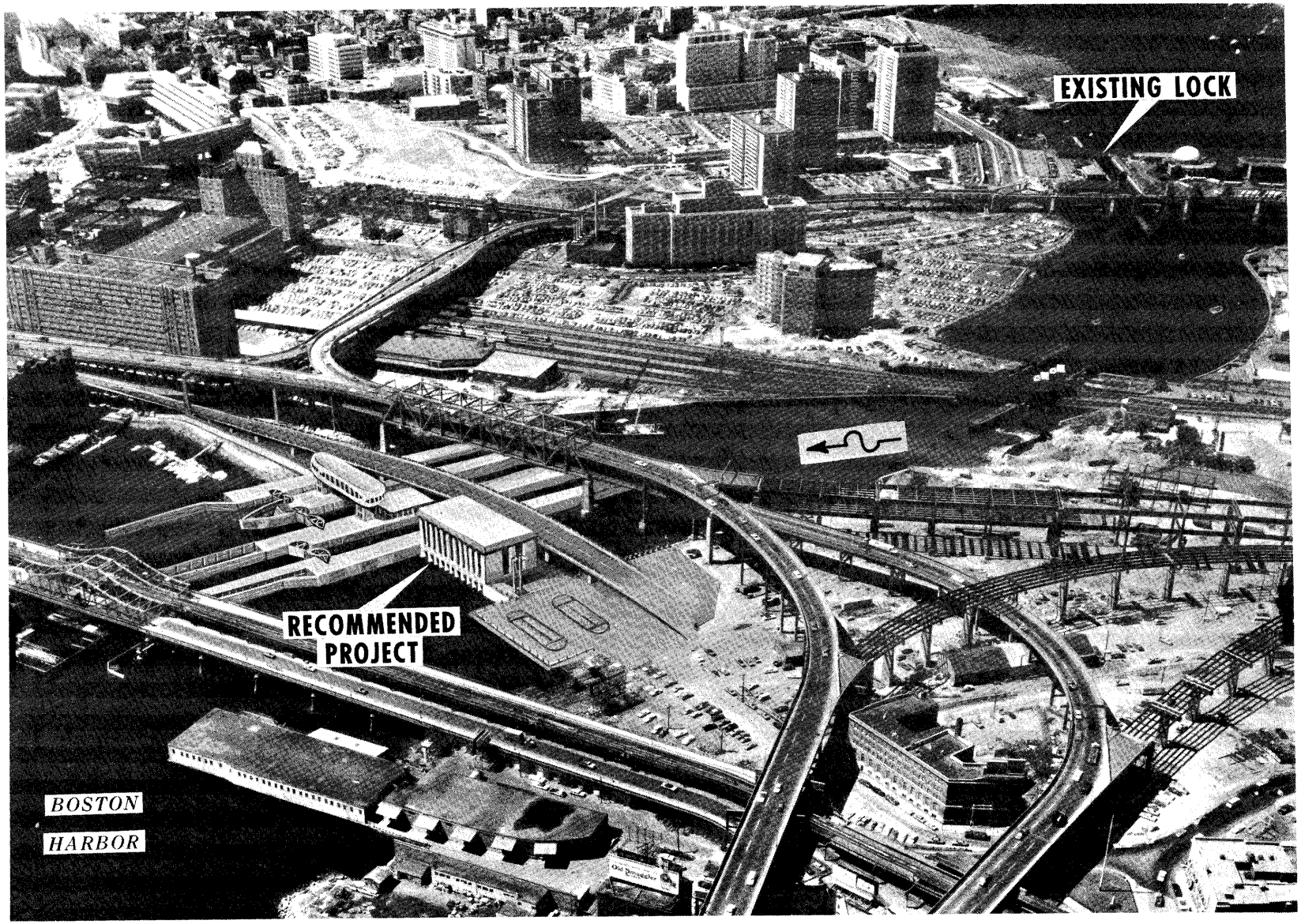
MASSACHUSETTS

DESIGN MEMORANDUM NO. 2

GENERAL DESIGN, SITE GEOLOGY AND RELOCATIONS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FEBRUARY 1972



CHARLES RIVER LOCKS AND DAM

WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER DAM

CHARLES RIVER BASIN

MASSACHUSETTS

DESIGN MEMORANDUM NO. 2
GENERAL DESIGN, SITE GEOLOGY AND RELOCATIONS

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WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER DAM
CHARLES RIVER BASIN
MASSACHUSETTS

DESIGN MEMORANDUM NO. 2
GENERAL DESIGN, SITE GEOLOGY AND RELOCATIONS

A. PERTINENT DATA

PURPOSE	Flood control, navigation and highway transportation
LOCATION	
State	Massachusetts
County	Suffolk
City	Boston
River	On the Charles River, at 0.7 river miles and approximately 2,250 feet downstream of the existing Charles River Lock and Dam.
DRAINAGE AREAS	
Total Charles River Watershed	307 square miles
Lower Charles River Basin (Above existing Charles River Dam to Moody Street Dam in Waltham, Massachusetts)	56 square miles
Lower Charles River Basin (Above proposed Dam to Moody Street Dam in Waltham, Mass.)	58 square miles

ELEVATION CONTROL

Recommended project	Metropolitan District Commission (MDC) Datum
MDC base	105.65 feet below mean sea level (MSL-U.S.C. & G.S. Datum)
Equation	105.65 feet MDC = 0.0 MSL

WATER SURFACE AREAS

Lower Charles River Basin at elevation 108.0 MDC:

Above existing dam	675 acres
Above proposed dam	705 acres

RECORD OF MAXIMUM BASIN FLOOD ELEVATIONS

Date	Elev. in Feet
Mar. 1936	109.3
July 1938	109.0
Sept. 1954	110.6
Aug. 1955	112.5
Mar. 1968	110.9
Dec. 1969	110.8

PUMPING STATION

Structure	Reinforced concrete substructure with reinforced concrete and steel superstructure
Size:	
Substructure	184' - 0" x 144' - 3". Intake sill elevation 82.5', MDC base
Superstructure	184 - 0" x 85' - 0"
Pumps	6 - 144" dia., 105 R.P.M.
Pumps, Capacity, Each	1,400 cfs @ 9' static head - Total 8,400 cfs
Engines	Diesel, each 2600 BHP w/right angle transmission gear unit drive

NAVIGATION LOCKS

Commercial (Large Lock)	One
Length	300'
Width	40'
Basin Sill Elev.	91.0' MDC base
Tidal Sill Elev.	86.0' MDC base
Recreational (Small Locks)	Two
Length	200'
Width	25'
Basin Sill Elev.	100.0' MDC base
Tidal Sill Elev.	94.0' MDC base
Gates	Sector
Large Lock	2 sections ea. 31' x 24' radius (Tide End) 2 sections ea. 26' x 24' radius (Basin End)
Small Lock	4 sections ea. 19' x 13.5' radius (Tide End) 4 sections ea. 15' x 13.5' radius (Basin End)

PERSONNEL BUILDING

Structure	Reinforced concrete
Size	70' x 20'

CONTROL TOWER

Structure	Steel frame encased in concrete
Size	94' - 4" x 14'

EMBANKMENT

Type	Earth fill with rock slope protection
Top Elevation	118.0' MDC base
Maximum Height	36' above river bed
Slopes	1 on 3
Total Length	630'

HIGHWAY VIADUCT

Type	Reinforced concrete and structural steel
Length	691.5'
Width	
Curb to Curb	52.0'
Out to Out of Parapets	61.5'
Bridge Span Arrangements	6 @ 60', 1 @ 60.5', 1 @ 62.25', 1 @ 63', 1 @ 65.75' and 1 @ 80'
Lanes	4 @ 12'

SLUICES

Low Sluice	8' x 10', sill elev. 87.0' MDC base
High Sluice	8' x 10', sill elev. 97.5' MDC base
Gates	Vertical Lift - Hydraulically operated

FISHWAY

Fishway (Weir Type) channel width	4'
Fish Lock Channel Width	6'
Fish Lock Floor Elev.	103.0' MDC base

PARKING FACILITIES

Boston	16 spaces
Charlestown	31 spaces

RELOCATIONS

Utilities	
Water 6" to 16" pipe, total	1,900'
Sewer & Storm Drainage	
6" to 36" pipe, total	665'
Marginal Conduit Systems	
Boston, 7½' Dia. Force Main	2,020'
Cambridge, 7' Dia. Sub-aqueous force Main	1,350'
Charlestown & Boston Relief Sewers	
5' to 7' Dia. conduits	3,230'

REAL ESTATE

Total to be acquired	4.4 acres
Structures to be acquired	1
Temporary Easements	1.6 acres

PRINCIPAL QUANTITIES

Excavation	181,700 c.y.
Embankment	139,000 c.y.
Stone Protection, Type I and II	56,100 tons
Stone Protection, Type III	2,600 s.y.
Concrete	84,100 c.y.
Cement	473,125 cwt.
Steel Reinforcement	3,220 tons
Lock Sector Gates	6
Lock Pumping and Culvert System	1 job
Lock Fender System	1 job
Precast Arch. Wall Panels	1 job
Aluminum Windows	1 job
1400 cfs Pumps	6
Electrical	1 job
Pump Station Equipment Test	1 job

ESTIMATED PROJECT COSTS (1971 Price Level)

Lands and Damages	$ 400,000
Relocations	7,100,000
Dam	1,600,000
Navigation Locks	13,500,000
Bridges (Viaduct)	800,000
Pumping Station	11,000,000
Engineering & Design	1,400,000
Supervision and Administration	2,000,000
TOTAL	$ 37,800,000

COST APPORTIONMENT

Project Feature	Federal	Non-Federal	Total
Lands & Damages	-	$ 400,000	$ 400,000
Relocations	-	7,100,000	7,100,000
Structures	$24,755,000	5,545,000	30,300,000
TOTAL PROJECT FIRST COSTS	$24,755,000	$13,045,000	$37,800,000

ECONOMIC ANALYSIS

Purpose	Annual Benefits	Allocated Annual Costs	Benefit/Cost Ratio
Flood Control	$2,235,000	$1,178,000	
Navigation	484,000	441,000	
Highway Transportation	80,000	62,000	
TOTAL	$2,799,000	$1,681,000	1.67
Redevelopment Benefits	136,000		
TOTAL	$2,935,000	$1,681,000	1.74

CONSTRUCTION PERIOD

Dam, Pumping Station, Navigation Locks, Highway Viaduct and Appurtenant Structures	3.5 Years

B. INTRODUCTION

1. PURPOSE. - The purpose of this Memorandum is to furnish and present information concerning the general plan, site geology and relocations for the Charles River Dam Project, and to serve as a basis for further planning and design studies.

2. SCOPE. - This memorandum covers the entire project and presents general data on the components, functions, costs and benefits of the Charles River Dam Project. The data contained herein will be supplemented and expanded, as required, by subsequent feature design memoranda.

C. PROJECT AUTHORIZATION

3. AUTHORIZATION. - The Charles River Dam Project was authorized by the Flood Control Act of 1968, Public Law 90-483, dated August 13, 1968, which reads in part as follows:

"The Project for flood control on the Lower Charles River, Massachusetts, is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 370, Ninetieth Congress, at an estimated cost of $18,620,000."

Construction of the Charles River Dam Project on Charles River in Boston, Massachusetts, for flood control, navigation and highway transportation was recommended provided that, prior to construction, local interests furnish assurances satisfactory to the Secretary of the Army that they will:

a. Provide without cost to the United States all lands, easements, and rights-of-way necessary for construction of the project;

b. Provide without cost to the United States alterations and relocations to existing sewerage and drainage facilities required to prevent their discharge into the pool above the dam;

c. Provide without cost to the United States all alterations and relocations of buildings, utilities, highways and other facilities made necessary by construction of the project;

d. Hold and save the United States free from damages due to the construction of the project, including water rights claims;

e. Prevent any encroachment on the basin, including the extension between the existing and new dams, which would decrease its flood storage effectiveness;

f. Continue to operate and maintain existing public use, access, and landing facilities for recreational boats, open to all on equal terms;

g. Provide public access to the new area of the basin between the new and existing dams, open to all on equal terms;

h. Regulate the use, growth, and development of navigation and navigation facilities in the basin, open to all on equal terms;

i. Establish regulations prohibiting discharge of pollutants into the waters of the basin by users thereof, which regulations shall be in accordance with applicable laws and regulations of Federal, State and local authorities responsible for pollution prevention and control;

j. Preserve present openings -- locks and sluices -- through the existing Charles River Dam in order to assure the continued flow of water and passage of boats through the dam;

k. Bear 18.3 percent of the total first cost of the structural features of the project, a sum which represents 50 percent of the cost of structural features allocated to navigation and 100 percent of the cost of structural features allocated to highway transportation; provided that such contribution may be paid either in a lump sum prior to commencement of construction or in installments prior to commencement of pertinent items, in accordance with construction schedules as required by the Chief of Engineers;

l. Operate and maintain all features of the project after its completion in accordance with regulations prescribed by the Secretary of the Army;

m. Furnish to the United States, without cost, all available engineering data pertinent to the project including plans prepared for the Metropolitan District Commission for construction of a dam at Warren Avenue.

D. INVESTIGATIONS

4. PREVIOUS INVESTIGATIONS. - Flood control in the Charles River watershed has been considered in the following reports:

a. Federal Studies

(1) NENYIAC Report - Flood control and allied water uses were considered in Part Two, Chapter XVI, titled "Massachusetts Coastal Area" of the report The Resources of the New England - New York Region. This

comprehensive report presented an inventory of the resources of the New England-New York area and recommended a coordinated plan to serve as a guide for the development, conservation and use of the land, water and related resources of the region. Prepared by the New England-New York Inter-Agency Committee, the report was submitted to the President of the United States by the Secretary of the Army on April 27, 1956. Part One and Chapter I of Part Two are printed as Senate Document No. 14, 85th Congress, 1st Session. The report, prepared prior to the August 1955 floods, found that flooding had not been a serious problem in the Massachusetts Coastal Areas.

(2) Reconnaissance Report (Unpublished). Under the authority contained in Section 205 of Public Law 87-874, adopted 23 October 1962, flooding and the flood problem along the Muddy River in the Boston - Brookline area were studied. In a letter type report dated 21 April 1966, entitled: "Reconnaissance Report - Local Protection, Muddy River, Boston - Brookline, Massachusetts", the Division Engineer recommended that in view of the cost limitation contained in Section 205 and the close relationship between flood stages of the Muddy and Charles Rivers, flood protection investigations be incorporated with the Charles River Basin Study.

(3) Survey Report. - The Interim Report on the Lower Charles River, Massachusetts, was submitted by the New England Division Engineer on 29 May 1968 for review by the Board of Engineers for Rivers and Harbors and subsequently published as House Document No. 370, 90th Congress, 2nd Session. The study was authorized by resolution of the Committee on Public Works, House of Representatives, adopted 24 June 1965, which reads as follows:

"That the Board of Engineers for Rivers and Harbors is hereby requested to review the report on Land and Water Resources of the New England-New York Region printed in Senate Document Numbered 14, 85th Congress, First Session, with particular reference to the Charles River Basin and tributaries, Massachusetts, with a view to determining the advisability of improvements in the interest of flood control, water supply, recreation, water quality control, navigation, tidal flood control, allied purposes and related land resources."

b. Non-Federal Studies

(1) Report of Committee on Charles River Dam with Report of John R. Freeman, Chief Engineer, 1903. - This report extensively investigated the feasibility and desirability of constructing a dam across the Charles River to create a constant pool, thus eliminating the unsightly and odoriferous tidal marsh. These studies recommended construction of the existing Charles River Dam.

(2) A Preliminary Planning Study, the Banks of the Charles River. - This study, prepared for the Metropolitan District Commission by Charles W. Eliot, Landscape Architect, in February 1961, investigated improvements and utilization of the Charles River and its banks. It took into account flood control, pollution control, navigation, recreational boating and other allied water uses. The report recommended that policies be established by the MDC to control these uses and properly develop the Charles River and its banks.

(3) Hydraulic Study - Proposed Muddy River Relocation. - This study, be Clarkson Engineering Company, Inc. was made in 1966 in conjunction with the design of the inner belt and southwest expressways (I-95 and I-695). The investigation considered the effect of new highway construction on the Muddy River, and recommended relocation of sections of the river and reinforcing and raising existing flood walls and dikes.

(4) Hurricane Study - The August 19, 1955 hurricane-storm caused extensive flood losses and serious disruption in built-up areas along the Charles River Basin, particularly in Boston and Cambridge. The Metropolitan District Commission engaged consulting engineering firms to study the flood problems and present solutions. The results of these studies, presented in a series of reports from 1956 through 1959, recommended the construction of "The Charles River Elevation Control Project" at Warren Avenue. Based on these recommendations, the Metropolitan District Commission initiated detailed design of the project to reduce flooding and improve navigation facilities on the Charles River. This plan of improvement was incorporated in the Corps' Survey Report and recommended for authorization and construction by the Federal Government.

5. CURRENT INVESTIGATIONS. - In order to determine the most practicable design for the project, data acquired in previous studies and past reports were fully utilized. Additional studies have been made as follows:

a. Studies for the project have utilized the basic data from the previous investigations updated and supplemented by new surveys and additional subsurface investigations.

b. Hydrologic and tidal hydraulic studies have been made to determine river flow, pumping and sluicing requirements, and the effect of tides. Design Memorandum No. 1, Hydrology and Tidal Hydraulics has been submitted and approved. Hydraulic design analyses concerning navigation locks and pumping station facilities are being prepared for submission as parts of the applicable feature design memoranda.

c. Geologic and Soils Investigations of foundation conditions are included in the Geology and Soils section of this memorandum.

d. Potential sources of concrete aggregates were investigated and reported in Design Memorandum No. 3, Concrete Materials, which has been submitted and approved.

e. Appraisals of land and damages in the project area are included in the Real Estate section of this memorandum.

f. Studies and preliminary estimates concerning relocation of affected utilities have been completed and are included in this memorandum.

g. Design Memoranda for Embankments and Foundations, Navigation Locks and Facilities, Pumping Station, Vehicular Viaduct and Cofferdams are currently in progress.

6. COORDINATION WITH OTHER AGENCIES. - The federal, state and local agencies listed below were asked to furnish their views. Letters of comment received are included in Appendix A.

Environmental Protection Agency, Water Quality Office.

U.S. Department of the Interior, Fish and Wildlife Service.

U.S. Department of Transportation, Bureau of Public Roads.

U.S. Department of Housing and Urban Development.

Commonwealth of Massachusetts, Metropolitan District Commission.

Commonwealth of Massachusetts, Department of Public Works.

Massachusetts Water Resources Commission.

Massachusetts Division of Fisheries and Game.

Massachusetts Water Pollution Control Division.

Massachusetts Bay Transportation Authority.

Massachusetts Department of Natural Resources.

New England River Basins Commission.

Boston Redevelopment Authority.

Metropolitan Area Planning Council.

Charles River Watershed Association.

7. PUBLIC HEARINGS. - Public hearings were held in January 1967, in Waltham, Wellesley and Franklin, Massachusetts, to determine the views and desires of local interests. The three hearings were attended by a total of nearly 500 persons some of whom were present at two or all three of the hearings. Attending were State and local officials, representatives of

other Federal agencies, members of a number of state and regional organizations and associations, representatives of local industrial and commercial interests, home owners and other private citizens. Desires were expressed for a number of improvement measures throughout the watershed including measures for environmental preservation, flood control, pollution control, flow augmentation, recreation, conservation and water supply.

E. LOCAL COOPERATION

8. GENERAL REQUIREMENTS. - Local cooperation, as primarily stated in Paragraph 3, above, is required. A request for formal assurances from the Commonwealth of Massachusetts, Metropolitan District Commission, will be made after approval of the General Design Memorandum. The Metropolitan District Commission furnished satisfactory assurances by letter dated 25 March 1969 in conjunction with the Water Resources Council's policy on revised interest rate for water resources projects. This letter is included as Exhibit 3 in Appendix A. More recent concurrence and willingness to participate in the construction of the project is expressed by the Metropolitan District Commission in their letter dated 27 September 1971 included as Exhibit 2 in Appendix A.

9. NON-FEDERAL COSTS.

a. Project Lands. - Local interests are required to provide all lands, easements, and rights-of-way necessary for construction of the project at an estimated cost of $400,000.

b. Sewerage and Drainage Facilities. - Alterations and relocations to existing sewerage and drainage facilities required to prevent their discharge into the pool above the dam will be constructed and paid for by local interests. The Metropolitan District Commission (MDC) has recently contracted with a consulting engineering firm to prepare engineering studies and detailed design for collection, treatment and conveyance of combined sewerage and storm drainage flows which presently discharge into the Charles River between the existing dam and the proposed project. At a meeting held in December 1971, the Commissioner stated that the engineering report and the detailed plans and specifications will be completed by late Fall 1972. This date conforms favorably with the proposed schedule for the start of construction of the dam. The work proposed to be accomplished by the MDC is estimated to cost about $14,000,000 of which $6,800,000 for alterations and relocations of existing sewerage and drainage facilities has been attributed to the construction of the Charles River Dam Project.

c. Utility Relocations. - Relocations and alterations of existing utilities made necessary by construction of the project will be paid for by local interests. The proposed relocations, estimated to cost $300,000, will be accomplished concurrently under the single continuing contract for the dam and appurtenant structures.

d. Project Features. - Local interests will bear 18.3 percent of the total first cost of the structural features of the project currently estimated at $5,545,000.

e. Operation and Maintenance. - The Metropolitan District Commission will operate and maintain all features of the project after its completion at an estimated annual cost of $317,000 including allowances for major replacements.

10. FEDERAL COSTS. - The net cost to the United States Federal Government for the recommended improvement is estimated at $24,755,000 for construction.

F. PROJECT LOCATION AND STREAM CHARACTERISTICS

11. PROJECT LOCATION. - The Charles River Dam will be located in the Boston inner harbor on the site of the former Warren Avenue Bridge across the Charles River between Boston and Charlestown, Massachusetts. The site is approximately 2,250 feet downstream of the existing Charles River Dam and about 300 feet upstream of the existing Charlestown Bridge (See Plate 2-2).

12. MAIN STREAM. - The Charles River rises at Echo Lake in the Town of Hopkinton, Massachusetts, about 25 miles southwest of the City of Boston at an elevation of approximately 347 feet above mean sea level. The river flows in a generally northeasterly course, winding back and forth through extensive swamplands and built-up areas for a total length of about 80 miles to tidewater at the existing Charles River Dam. The basin has a total drainage area of 307 square miles. It falls a total of about 345 feet from its headwaters to the Charles River Basin in Watertown. From this point the basin extends 8.6 miles to the existing Charles River Dam. For hydrologic reasons, as discussed in Design Memorandum No. 1, only the lower $12\frac{1}{2}$ miles of this river concerns the proposed project. This is known as the Lower Charles River Watershed which extends from the Moody Street Dam in Waltham to tidewater. The drainage area of the lower watershed shown on Plate 2-1, covers 56 square miles behind the existing dam and an additional 2 square miles between the existing and proposed dam. Muddy River, Stony Brook and Beaver Brook are the major tributaries which empty into the main stream in the lower watershed. These three tributaries drain 60 percent of the watershed for the lower Charles River. A description of these tributaries is presented in Design Memorandum No. 1 "Hydrology and Tidal Hydraulics", approved 2 August 1971.

13. FLOODED AREA.

a. General. - Over 1,750 acres lying along both banks of the 8.6 mile-long pool or Basin above Charles River Dam are subject to fresh water flood problems due to higher stages in the Basin. In this reach the river is the boundary between Boston and Cambridge, Boston and Watertown,

and at its upper end, between Newton and Watertown. Near the lower end of the Basin, Muddy River, entering from the southwest, drains a sizeable portion of the Town of Brookline.

b. Boston Area. - In Boston, the flood plain is covered by a rather complex mix of public and private institutions, private and commercial residential facilities and other commercial properties. Among the larger institutional properties involved are the Massachusetts General Hospital, Boston University, and the Business Administration School of Harvard University. Lying between the built-over portion of the flood plain and the river is Storrow Drive and its westerly extension, Soldiers Field Road. These are the region's major traffic arteries connecting the suburbs to the west and north of Boston to the downstown area and to expressways (to the south and northeast). Also accupying the flood plain are the main line and the Beacon Park yards of the former Boston and Albany Railroad and the Boston extension of the Massachusetts Turnpike, much of which was constructed above the level of known flooding.

c. Cambridge Area. - On the Cambridge side of the river, the lower or eastern end of the flood plain is built over with a mixture of industrial and commercial properties with some scattered obsolete residential properties. The western edge of this area is adjoined by the Massachusetts Institute of Technology and research facilities which have grown up around the Institute. West of the Institute, the flood plain is occupied by commercial and residential properties, a public utility plant, the main campus of Harvard University, Mount Auburn Hospital and private school property. As in Boston, the river bank is edged by a major traffic artery, Memorial Drive, which carries Massachusetts Routes 2 and 3 to the west and north and U.S. Route 1 to the north and east.

d. Newton and Watertown Areas. - In Newton and Watertown, the flood plain is less intensively developed than in the cities to the east. Highways and some recreational facilities of the Metropolitan District Commission are the principal occupants of the flood plain.

e. Boston and Brookline Areas. - Along Muddy River in Boston and Brookline, the flood plain is occupied by commercial and residential properties, Boston Museum of Fine Arts, public park land and trackage of the Massachusetts Bay Transportation Authority's rapid transit line between Boston and Newton.

G. PROJECT PLAN

14. DESCRIPTION. - The recommended project plan, as shown on Plate 2-3, consists of the construction of an earthen dam across the Charles River with a river pumping station, three navigation locks, a highway viaduct, control

tower, personnel building, fish passage facilities and sluiceways to pass normal flows. The locks and pumping station structures will be connected to the north and south abutments by the earthen dam. The highway viaduct will be constructed over the entire structure to provide motor vehicle transportation between Boston and Charlestown. The recommended construction works require relocations of water, gas, electric and telephone lines across the river and extension of the Boston marginal conduit through the new dam to prevent sewage releases into the pool area between the existing and recommended dams. The structures, improvements and relocations are described in detail further in this report and are shown on plates following the text.

H. DEPARTURES FROM THE PROJECT DOCUMENT PLAN

15. DEPARTURES. - The following modifications and changes from the authorized project plan have been made in the development of detailed design studies based on additional information acquired.

a. Two sluices, each 8 feet wide and 10 feet high have been added at the north side of the pumping station. A third sluice, 6 feet square has been provided in the fish lock.

b. The submerged fishway located in the large lock wall was eliminated. New fish passage and viewing facilities designed in accordance with recommendations of the U.S. Fish and Wildlife Service will be located north of the pumping station.

16. REASONS FOR DEPARTURES.

a. The sluices were added to provide greater operational flexibility in the discharging of freshet flows on the river and in reducing the frequency of having to sluice through the navigation locks.

b. The new fish passage and viewing facilities were provided north of the pumping station as a result of studies made by the Fish and Wildlife Service which indicated that the previously proposed fish passage was unsatisfactory. The report prepared by the U.S. Fish and Wildlife Service is included in Appendix C.

I. HYDROLOGY AND TIDAL HYDRAULICS

17. GENERAL. - Over 1,750 acres along both banks of the 8.6-mile long Basin above the existing Charles River Dam are subject to floods which usually originate over the lower urban watershed. The Basin is maintained at 108 feet (MDC base) or 2.35 feet msl. Below the dam, two high and low tides occur each lunar day with a mean tide range of 9.54 feet and a mean high water elevation of 110.2 feet, MDC base. Therefore, there are periods during each tide cycle when water from the Basin cannot be discharged by gravity into the harbor.

18. STANDARD PROJECT FLOOD. - The standard project flood was developed for use as a basis of design for the proposed improvements. Using criteria prescribed in EM 1110-2-1411, it was based on the rainfall derived from a standard project storm centered over the lower 58 square miles of watershed and a coincident flow of about 3,000 cfs from the upper 251 square miles of drainage area above Waltham. Total peak inflow to the Charles River Basin of 20,000 cfs was assumed to occur simultaneously with high tide in Boston Harbor. By prelowering the basin to elevation 106.5 feet, MDC base and operating 6 pumps at 1,400 cfs each, the basin would rise to elevation 110.5 feet, MDC base or 0.3 feet above significant damage stage.

A project design flood (15,500 cfs) developed by the MDC was patterned after the August 1955 flood and was used for demonstration purposes. Details for both floods are shown in Design Memorandum No. 1, "Hydrology and Tidal Hydraulics".

19. PRELOWERING OF BASIN. - Present practice is to prelower the Basin based on the amount of precipitation at the dam. Originally the Basin could endure a 3-foot fluctuation above or below elevation 108 feet, MDC base. However, development over the past 50 years has reduced this amount to about 2 feet. The upper limit results from flood damages and the lower limit from the exposure of industrial water intakes and the possible structural damage to buildings. It is planned to prelower the Basin to elevation 107 feet during minor and moderate flood periods and to a minimum of 106.5 feet during the most intense storm periods.

20. PUMP CAPACITY. - A pumping station consisting of 6 pumps, each with a capacity of 1,400 cfs has been selected for handling flood flows coincident with high tides in the harbor.

21. TOP OF DAM. - The selection of the height of dam at elevation 118 feet, MDC base, was predicated on both, the tidal and river flooding conditions and the physical land features at the dam site. An evaluation of the top of dam elevation is included in Section N of this report.

22. SLUICING. - The normal Charles River flow will be discharged into the harbor through two sluices, each 8 feet wide and 10 feet high. In addition, a 6 x 6 foot combination fish lock and sluice can be used. When the inflow exceeds the capacity of the sluices, a pump will be used to discharge excess flows. During major floods, boating will be curtailed and one or more of the boat locks together with pumps and sluices will be used to pass flood flows through the dam.

Rating tables for the discharge facilities are presented in Design Memorandum No. 1, "Hydrology and Tidal Hydraulics"; however, Table 1 presents a brief summary of the discharge capabilities of these facilities.

TABLE 1

DISCHARGE FACILITIES

Feature	Harbor Elevation	Basin Elevations * 110	109	108
		(Discharge in cfs)		
8' x 10' Sluice	109	530	-	-
	108	740	530	-
	107	900	740	530
Small Boat Lock (25' Wide)	109	1,600	-	-
	108	2,025	1,450	-
	107	2,050	1,650	1,250
Large Boat Lock (40' Wide)	109	5,600	-	-
	108	7,300	5,300	-
	107	8,200	6,900	4,750
Fish Lock (6' Wide)	109	245	-	-
	108	300	205	-
	107	325	245	165

	Basin Elevations *	Basin Elevations ** 111	110	109
		(Discharge in cfs)		
Existing Dam Openings (Lock & Sluices)	110	10,000	-	-
	109	14,200	9,000	-
	108	16,700	13,200	8,800

* Refers to water elevations between existing and proposed dams.
** Refers to water elevations upstream of existing Charles River Dam.

All Elevations are in Feet, MDC Base.

J. WATER QUALITY

23. GENERAL. - A detailed report on the quality of water in the Charles River Basin is contained in Appendix H of the "Interim Report on Charles River for Flood Control and Navigation, Lower Charles River, Massachusetts," published by the Corps in May 1968. The appendix, prepared by the Federal Water Pollution Control Administration, thoroughly describes the highly polluted state of the lower Charles River.

The major pollutants are bacterial and organic in nature and are introduced to the river by the frequent discharge of numerous combined sanitary and storm overflow sewers located along the entire reach below Moody Street Dam in Waltham. The Metropolitan District Commission, which operates the greater portion of this extensive sewerage system, has embarked on a program to improve these conditions. This program, which is discussed in the above referenced report, will focus on reducing or eliminating entirely the frequent combined sewerage overflows and will actually provide for detention and chemical treatment of excess storm flows.

24. STREAM CLASSIFICATION. - The Massachusetts Division of Water Pollution Control has established a class C category for the Charles River between the Watertown and Charles River dams. Class C waters are suitable habitat for wildlife and common food and game fishes indigenous to the region and are of good aesthetic value. The tidal portion of the Charles River below the existing dam has been classified SC. This class designates marine waters which are suitable for aesthetic enjoyment; for recreational boating; habitat for wildlife and common food and game fishes; and industrial cooling and process uses. An active program to enforce these standards will result in major improvement of the river's water quality. Massachusetts standards of quality for class C and SC waters are contained in Appendix D.

25. EFFECTS OF EXISTING DAM. - The salt water content in the Charles River Basin fluctuates periodically throughout the year. Generally, the salt content increases steadily during the summer and early fall because of increased number of lockages at the Charles River Dam and low fresh water inflows. During prolonged dry spells when inflow into the Basin is exceeded by the losses from the Basin, it has been necessary to add quantities of salt water to maintain adequate Basin levels. During late fall or early spring following high river inflows, the salt water content decreases. For example, in 1967, the chloride content near the surface of the Charles River on the upstream side of the Charles River Dam varied from 185 mg/l on 11 April to 2,200 mg/l on 2 October and then decreased to 850 mg/l on 12 December.

Numerous chloride tests show a substantial stratification throughout the Basin between Watertown Dam and Charles River Dam, particularly in the late summer and early fall. A stagnant salt water wedge is

formed on the bottom of the river because of the greater density. Because of this wedge, vertical circulation of water and absorption of oxygen become greatly reduced. Due to the lack of oxygen, anaerobic respiration of settled organic matter at times has caused highly objectionable odors.

26. EFFECTS OF PROPOSED PROJECT. - The proposed Charles River Dam will include two features which will serve to alleviate the salt water intrusion problem during normal operations. Descriptions of these improvements follow:

(1) A low level 8 x 10 foot sluiceway at invert elevation 87.0 feet, MDC base is provided to withdraw the heavier salt water and silt which accumulates at the bottom of the Basin.

(2) When the tidewater level is above the Basin level, a pump is provided to discharge excess waters from the locks to tidewater thus reducing the flow of salt water into the Basin. At the present dam under the same operating conditions discharge of excess waters from the locks can only be accomplished by gravity with the result being that salt water is discharged to the Basin.

Construction of these features which control the amount of salt water intrusion will in turn permit improved mixing of waters in the Basin and will improve the distribution of oxygen. The total result should be a lessening of the anaerobic conditions prevailing at the bottom of the Basin with a subsequent reduction in objectionable odors which presently emanate from this source.

27. RELOCATION OF MARGINAL CONDUITS. - As part of the local assurances for this project, the MDC will relocate the outfall of the Boston and Cambridge marginal conduits from their present locations. The Boston marginal conduit will be extended from the existing dam to a new location in tidewater below the proposed damsite. The Cambridge marginal conduit will be connected to the Boston marginal conduit. These are essential parts of construction to control the degradation of water quality in the newly formed Basin.

K. GEOLOGY AND SOILS

28. SITE GEOLOGY. -

a. General. - The damsite is located on the Charles River, a tidal estuary to Boston Inner Harbor. The area is part of the Boston Lowland and once consisted of mainly tidal flats and salt marshes that have been progressively reclaimed and filled since Colonial days so that present shorelines are well beyond their former positions. The Lowland is part of the Boston Basin, a structural synclinal basin occupied by rocks of Carboniferous age consisting of siltstone, slate, conglomerate and volcanics. The Cambridge Slate

occurs in the site area. The "slate" is generally fine-grained and composed chiefly of argillaceous material, usually massive rather than slaty and therefore better termed an "argillite". In some areas in the Boston Basin, the argillite may be altered to a clay-like consistency to significant depths. The bedrock is overlain by Pleistocene deposits consisting of glacial till or hardpan and glacial outwash sediments of sands and clays. Recent marine deposits of organic silt, mud and peat overlay the glacial deposits and in turn are extensively overlain in some areas by man-made fills. The subsurface picture is generally depicted on Plate 2-16.

b. Subsurface Explorations. - Test borings (32) were made in 1948 for the rebuilding of the Warren Avenue bridge and are on or applicable to the dam site as are to a lesser degree about 20 borings made in 1950-51 for the Central Artery bridge located just upstream of the site. In 1963, 74 borings were made for the Metropolitan District Commission on a grid pattern of 75 feet except where prevented by existing structures. The MDC borings and previous borings were of standard penetration type common to explorations made in the Boston area. These borings were sampled at 5-foot intervals using a 24-inch split spoon of 1-3/8 inches I.D. driven by a 140 pound drop weight falling 30 inches. Borings were taken to refusal and at a few locations refusals were established as bedrock by coring.

In 1970, the New England Division made 12 borings, FD-1 to FD-12, to further delineate the surface of the glacial till, and established bedrock by coring refusals in 4 of the borings, FD-1, 2, 3, and 6. These borings were made using a solid 5-foot sample spoon of 2 inches or 1-1/2 inches I.D. driven by a 300 pound or 350 pound drop weight falling about 18 inches. Additionally, a 6-inch diameter boring was made to recover undisturbed samples for testing of the organic silt stratum which will remain in the foundation for portions of the earth embankments and temporary construction slopes. A plan of explorations is shown on Plate 2-16. Graphic logs of selected borings are shown on Plate 2-17.

29. FOUNDATION CONDITIONS. -

a. General. - Feature foundation designs will be covered in pertinent portions of forthcoming design memoranda, "Embankments and Foundations", "Navigation Locks and Facilities", "Pumping Station", and "Vehicular Viaduct."

b. Foundations. - The dam will extend across the Charles River estuary which is about 500 feet wide at the project site. The structures for the navigation locks and the pumping station will be founded in or on dense glacial till overlying bedrock. The glacial

till consists of compact gravelly clayey sand and gravelly sandy clay with occasional cobbles and boulders. Density tests on drive sample plugs indicate that the dry unit weight of the till ranges from 130 to 145 p.c.f. In portions of some of the recent borings, it was possible to recover samples of the till by the rock-coring method. The Boston Building Code allows a bearing value of 10 tons per square foot on "hardpan" or till and this value may be exceeded by 5% for each foot of additional depth, not exceeding three times the initial bearing value.

The vehicular viaduct approach piers will be on piles. The piles will extend through man-made fills and organic silt into glacial till or to bedrock. The earth embankment portions of the dam are located at both abutment reaches. On the Boston shore, the embankment forms part of the vehicular viaduct approach fill. The selection of embankment height and width are dictated by geometric highway requirements. The fills will consist of granular material and the embankment will have necessary slope protection.

30. SEISMICITY. - The Boston area is placed in the category of high risk rating (Zone 3) according to the seismic risk map recently developed by the Environmental Sciences Service Administration and the Coastal and Geodetic Survey. This rating implies that major damage could occur in Boston and apparently stems mainly from the severe earthquakes of 1727 and 1755. These quakes have been assigned on the basis of damages and accounts, intensities of IX with aftershocks of intensities up to VI according to the Modified Mercalli Scale. Damage at the high intensity would be considerable even in specially designed structures. Earthquake damage is usually greater in structures founded on loose or soft soils than on bedrock. As discussed under "Foundations", all concrete and steel structures will be well founded on or in dense glacial till underlain by bedrock. According to Engineering Technical Letter No. 1110-2-109, 21 October 1970, hydraulic structures in Zone 3 will be designed to withstand earthquake acceleration of .10g.

31. CONSTRUCTION MATERIALS. - Materials for embankment fills and stone for slope protection will be contractor furnished except for use of acceptable materials from required excavations. Concrete aggregate from three competitive sources in the Boston area have been tested and reported in the Design Memorandum No. 3, "Concrete Materials."

L. OTHER PLANS INVESTIGATED

32. FLOOD CONTROL. - Several alternative plans for flood control were studied. Consideration was given to the possibilities of upstream reservoir storage, perimeter diking, diversion and the provision of pumping facilities to afford a reasonably constant level in the Basin at all times.

a. Upstream Reservoir Storage. - A review of all of the recent major floods revealed that the runoff from the lower 56 square miles of the watershed contributed up to 90 percent of the total inflow to the basin, and also that the peak inflow from the lower watershed occurred within 2 to 3 hours after the storm, indicating the importance of local inflow to the Basin. It was evident, therefore, that upstream reservoir storage or diversion out of the watershed, would have little or no effect on reducing the Basin inflow. Reservoir storage on the lower tributaries which drain into the Basin will be effective in reducing floodflows, however, the widespread distribution, the large number of storage areas required and the highly urbanized nature of the basin make such plans economically prohibitive.

b. Perimeter Diking. - Local protection measures consisting of diking miles of riverfront and providing numerous small pumping stations to control the interior drainage were also studied. These studies were discontinued because the cost of providing protection of this nature exceeded $50 million. In addition, the construction of dikes in many areas would destroy the scenic and aesthetic values currently being preserved.

c. Diversion of Flows. - An investigation was made to divert additional Charles River flows to the adjacent watershed by way of Mother Brook which now diverts flows to the Neponset River. However, this brook is situated about 25 miles above the mouth of the Charles River and is too far upstream to be effective in reducing peak levels in the lower Basin.

d. Flood-Proofing and Zoning Measures. - Consideration was also given to the possibilities of using a combination of flood-proofing and zoning measures to decrease future flood damages in the area adjacent to the Basin. It was determined that such measures could not be readily and economically achieved except through the expenditure of great sums of money and through the complete disruption of city functions. This consideration would not provide protection to the extremely heavy vehicular traffic using the main arteries on both banks of the river. Further studies were discontinued.

e. Basin Level Control. - In view of the more rapid filling of the Basin that is now being experienced following heavy rainfalls, control of the water level in the Basin through the provision of a pumping station was considered the one positive and economically feasible method of securing desired results. Five alternate locations for a pumping station at the existing dam were studied. Three utilized the existing lock as a discharge channel, and one required the installation of a discharge conduit through the existing dam. The fifth scheme used the existing lock as an entrance channel to the pumping station located downstream of the lock. This proposal required an extension to the lock and installation of a new lock gate.

All five plans were either physically or financially not feasible owing to unusually difficult and costly foundation conditions, undesirable hydraulic characteristics and other problems, such as, the interruption of navigation during the construction period. Further, these plans would not provide for existing and future navigation needs. All five plans were abandoned.

33. LOCKING FACILITIES. - Consideration was given to improving locking facilities at the existing dam. However, the greater part of the top of dam, comprising of about 7 acres, is now occupied by the Museum of Science with an investment in facilities of about $15 million. Because of these facilities, the sole existing lock could not be enlarged and additional locks could not economically or physically be provided.

M. DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

34. GENERAL. - The Charles River Dam will be a multiple-purpose project with provisions for flood control, recreational and commercial navigation, and highway transportation. The project will consist of an earth dam with three navigation locks, a river pumping station, a highway viaduct, control tower, personnel building, fish passage facilities and sluiceways. The vehicular viaduct will be constructed over the dam and locks and along the upstream side of the pumping station. Fish passage and sluicing facilities will be constructed to the north of the pumping station. Design details are currently in progress and will be presented in feature design memoranda. Structural elements of the project are presented in the following paragraphs.

35. PUMPING STATION. - The pumping station superstructure will be 184 feet long by 85 feet wide and will contain 6 vertical open type pumps driven through right angle transmission gear units by diesel engines (2,600 BHP) located on the operating floor. The pumps will have a total capacity of 8,400 c.f.s. at a pool to pool head of 9 feet. The substructure of the station will be 184 feet by 144.25 feet including the forebays constructed of reinforced concrete. The superstructure will be constructed of precast concrete panels supported on a concrete encased structural steel frame. Pumping station plans and details are shown on Plates 2-6, 2-7 and 2-8.

36. NAVIGATION LOCKS. - Three navigation locks will be constructed for the passage of commercial and recreational boating. One large lock, 300 feet long and 40 feet wide, will be provided for commercial traffic. The depth of water over the tide sill for this lock will be 14.8 feet at mean low water, 19.6 feet at mean sea level and 24.2 feet at mean high water. Two smaller locks for use by recreational boating will be 200 feet long by 25 feet wide.

The depth of water over the tide sill for these smaller locks will be 6.8 feet at mean low water, 11.6 feet at mean sea level, and 16.2 feet at mean high water. Each lock will have two sector gates consisting of structural steel members covered by a curved steel skin plate. Typical plans and sections for the navigation locks are shown on Plates 2-5 and 2-6.

37. EMBANKMENT. - An earth section, faced with stone protection and having 1 on 3 side slopes, will connect the river structure to the Boston shore. Within this section, 280 feet of 90-inch diameter reinforced concrete force main (Boston marginal conduit) will be constructed. Connections from the river structure to the Charlestown shore will be by an earth section contained by upstream and downstream reinforced concrete walls. Paved roads will be constructed on the top of the dam for access to the river structures by maintenance vehicles. Typical embankment sections are shown on Plate 2-4.

38. VEHICULAR VIADUCT. - The highway viaduct will be a multi-span bridge approximately 691.5 feet long and 61.5 feet wide. The bridge consists of a reinforced concrete substructure supported partly on the navigation lock and the forebay structures of the pumping station and partly on pile supported concrete footings. The bridge superstructure will be a reinforced concrete bridge deck mechanically anchored to steel rolled beam stringers. On the Boston side the approach section will be an earth fill retained by a pile supported gravity type abutment with wing walls. On the Charlestown side, the viaduct will be an elevated section which will be later connected to extensions of the currently planned network of expressways in the Boston area. Plate No. 2-11 shows the plan and profile of the viaduct.

39. CONTROL TOWER. - The control tower will be 94.3 feet long by 14 feet wide constructed with a steel frame encased in concrete. This structure will span across small lock No. 2 and will be supported on two reinforced concrete piers. Consoles containing operating equipment for control of the navigation locks will be located in the tower. A typical elevation and section are shown on Plate No. 2-9.

40. PERSONNEL BUILDING. - The personnel building will be a reinforced concrete structure 70 feet long by 20 feet wide. It will be located on the lock wall between the large lock and small lock No. 2. An equipment storage area will be provided beneath the floor of this building. Located within the building will be necessary administrative office space. Plate No. 2-10 shows the general plan and elevations for this structure.

41. FISH PASSAGE FACILITIES. - Fish passage facilities will consist of a conventional weir type fishway 4 feet wide and a combination

sluice and fish lock 5 feet wide. The weir type fishway will be operated when the tide level is at or below the basin level which occurs approximately 7.5 hours for every 12.5 hour period. During the period of time when the tide is above the basin level, the combination sluice and fish lock will be operated. A visitor area will be provided near the fish passage facilities to accommodate public viewing of fish migration. The layout of these facilities is shown on Plate No. 2-7.

42. SLUICEWAYS. - In addition to the combination sluice and fish lock described above, two 8-foot by 10-foot reinforced concrete sluiceways will be constructed north of the pumping station to pass normal freshet flows. These sluices will have hydraulically operated vertical lift gates. The sill elevation of the low sluiceway will be set at elevation 87.0 feet, MDC base and the high sluiceway at elevation 97.5 feet, MDC base. The layout of these sluiceways is shown on Plate No. 2-7.

43. PARKING FACILITIES. - Two bituminous concrete paved parking areas will be constructed at the project site. In Boston, a total of 16 parking spaces will be provided upstream of the dam. A total of 31 parking spaces will be provided in Charlestown on the dam. The locations of these parking areas are shown on Plate 2-2 and the layout and typical pavement details are shown on Plates 2-12 through 2-14.

44. RIVER CONSTRUCTION. -

a. General. - The ruins remaining from the Warren Avenue bridge will be removed and the soft organic river bed materials will be excavated in the wet. The construction of the river structures and portions of the earth embankment will be done within dewatered cellular cofferdams. It is anticipated that construction will be carried out in two stages. The pumping station, large lock, fish passage facilities, sluiceways and a portion of the connecting embankment on the north side will be initiated in the first stage. Construction of the two small locks and portions of the earth embankment connection to the south side of the river will be inside the second stage cofferdam.

b. Bypass Channel. - A temporary channel, approximately 60 feet wide with a bottom elevation at 80 feet, MDC base, will be provided along the Boston shore between the Stage I cofferdam and the existing bridge pier of the John F. Fitzgerald Expressway (See Plate 2-15). This channel will serve the dual purpose of acting as a navigation channel for boat traffic and also for passing flows during Stage I construction. The channel will be dredged and the bottom and side slope will be treated with stone protection. This

channel will permit passage of storm outflows of a 20-year frequency (10,000 cfs) and will result in a channel velocity of approximately 8 fps at mean low water and 6.5 fps at mean tide level.

During the second stage construction, when the pumping station and the large navigation lock have been constructed, the river flows and boat traffic will pass through the large lock.

45. INSTRUMENTATION. -

a. General. - The instrumentation for the project structures will feature measurement of uplift and settlement markers for use in periodic inspection. The layout and number of instruments will be indicated in Design Memorandum No. 7, "Navigation Locks and Facilities." The instrumentation will be provided in accordance with the latest edition of the following references:

ER 1110-2-1150	Post Authorization Studies
ER 1110-2-100	Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures
EM 1110-2-4300	Instrumentation for Measurement of Structural Behavior of Concrete Gravity Structures

b. Uplift. - Pore pressure cells of the electrical transducer type will be installed to measure uplift in a pattern which will indicate water pressure in the foundation on the harbor side, basin side and center of structures.

c. Alignment or Deflection Line Facilities. - These will not be provided since the locks and pumping station are acted upon by low differential water pressure (maximum 14 feet); however, settlement reference points will be utilized.

d. Settlement Reference Points. - Monuments or plates will be embedded in the concrete at appropriate locations on top of abutments or walls to allow precise levels to be performed and recorded.

e. Settlement Platforms. - Settlement platforms will be installed between viaduct stations 46+00 and 53+60 prior to the construction of earth fill for the viaduct ramp at the Boston side. It is expected that several inches of settlement will occur in this reach due to the existence of the organic silt zone beneath the present fill. These platforms will be of the simple type consisting of a horizontal plate with an extendable vertical rod (threaded pipe). Settlement readings of these platforms during and after construction of the earth fill will be used to dictate the time of starting construction of the paved road surface as discussed in the Design Memorandum No. 4, Embankments and Foundations.

N. PROJECT FORMULATION AND EVALUATION

46. GENERAL. - The need for flood protection and improved navigation passage facilities was identified through studies conducted for the Metropolitan District Commission (MDC) before initiation of the Corps investigation of its Charles River Basin study in FY 1966. The MDC prepared plans and specifications and had some construction funds available. At the time of the Corps study the MDC was preparing to request additional funding authority from the Massachusetts legislature. The request was subsequently deferred to await completion of the interim report which identified the feasibility and degree of Federal participation.

The MDC studies included an in-depth analysis of all possible alternatives. The Corps studies reviewed the alternatives for technical and economical adequacy. Plan formulation studies centered on confirming that the plan as designed by the MDC represented the optimum development for each project purpose and is consistent with Corps policies and procedures. A detailed description of individual project purposes follows.

47. FLOOD CONTROL.

a. Basin Level Control. - The existing Charles River Dam was constructed in 1910 to create a fresh water Basin known as the Charles River Basin. Primary objectives of the project included elimination of extensive mud flats and consequent nuisance at low tide, protection of large low areas in Boston and Cambridge from tidal flooding; stabilization of the ground water table in adjoining areas, and the creation of a significant water body for recreational purposes. A design objective was to maintain the basin at a permanent elevation of 108 feet MDC datum.

The depth of the Basin generally varies from 3 to 15 feet with a maximum of 30 feet. At the design elevation of 108 feet, the water surface area of 675 acres has a shore line of approximately 20 miles. Prior to the construction of the dam, the area along the Basin and the tributary streams had been subjected to frequent tides up to elevation 112-113 feet and construction of facilities vulnerable to such levels was restricted, both by ordinance and by consequences of encroachment below such an elevation.

Installation and use of facilities prior to dam construction were also subject to low tide levels of elevation 100 feet or lower, and the then contemplated future occasional prelowering of the Basin possibly to elevation 105 feet obviously presented no problems. However, the relatively consistent regulations of the Basin within

close proximity to elevation 108 feet for many years led to extensive construction of adjacent facilities at appreciably lower elevations than had been considered in the original design. Therefore, the restrictions and ordinances in effect prior to construction of the dam appeared to become less important and were accordingly violated. It appears that most of the facilities constructed had been made on the assumption of continuous control of the Basin at elevation 108 feet. Again, over the years, the sustained basin elevation normally in close accord with elevation 108 feet has led to uses which are dependent upon limited drawdown of the Basin, with consequent objections to elevations at or below 107 feet for any length of time.

b. Top of Dam.- The selection of the height of dam was predicated on both the tidal and river flooding conditions and the physical land features at the dam site. The history of hurricanes and other severe coastal storms in Massachusetts goes back to 1635. Past hurricanes have resulted in serious tidal flooding along the coast of Massachusetts south of Cape Cod. However, the problem of hurricane tidal flooding in Boston Harbor has not been serious because of protection afforded by surrounding ground from high sustained winds from the south. Slow moving severe coastal storms, commonly called "northeasters", have caused the highest tides in Boston Harbor. These storms with prolonged periods of easterly and northeasterly winds result in the greatest tidal flood levels.

The dam site is sheltered from ocean waves, and has only a short tidal fetch of about 1,300 yards; therefore, wave action is not considered to be of consequence at the project. The highest recorded tide at Boston, adjusted to 1970 levels, occurred in April 1851 with an elevation of 11 feet, msl, or 116.6 feet, MDC datum.

The upper limit in height of dam was governed by surrounding land elevations. The topography south of the site is generally between elevation 117 and 118 MDC datum. Thus, raising the dam above 118 would not be realistic without extensive filling or diking to prevent tidal flooding around the right abutment. Such filling or diking in the center of urban Boston for the purpose of preventing this extremely rare event from occurring is not economically or aesthetically feasible. The minimum top of dam was selected at elevation 118 feet, MDC, which is 1.4 feet above the highest recorded harbor tide.

The amount of overtopping that could safely be handled was determined on the assumption that a tidal flood occurred which was 2.5 feet higher than any flood level previously experienced and coincident with a 10 year rainstorm over the Charles River Basin. For these conditions, the pumps will be operable and could handle interior runoff and overtopping without causing a significant rise in the basin level.

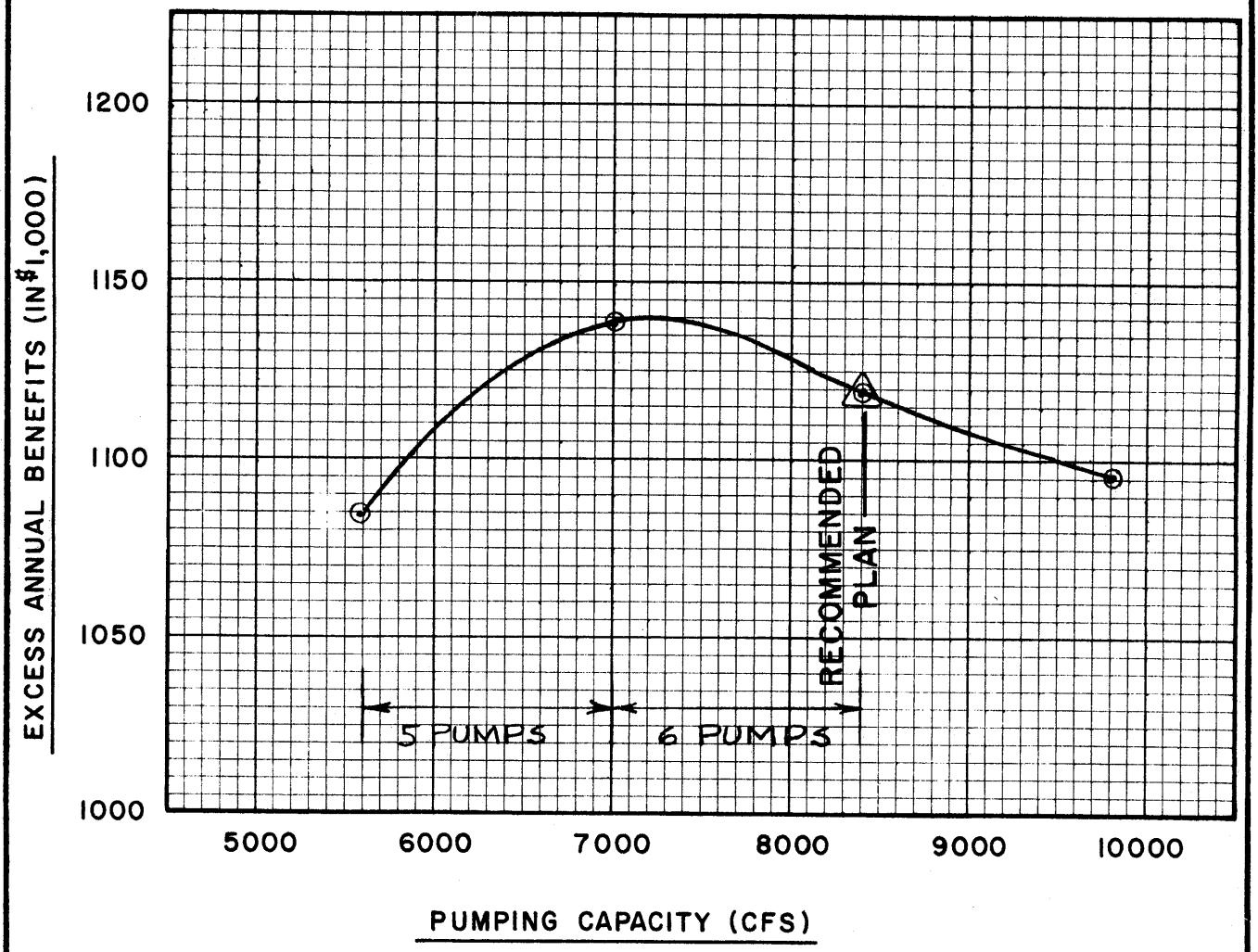
During the freshwater standard project flood and with pumps in full operation, the Basin would rise to elevation 110.5 feet MDC. With the top of dam at elevation 118, there is ample freeboard from river flooding.

c. Pumping Capacity. - A major flood problem stems from the flooding of the commercial, industrial and institutional properties in the intensively developed flood prone areas along the shores of the Charles River Basin, particularly in Boston and Cambridge. Increases in the water level of the basin, in excess of 18 inches above the normal pool level, causes the inundation of adjacent low areas and highways and back-up through sewers and drains into the basements of numerous buildings. The problem has become particularly severe owing to the extensive urban growth that has been taking place in the area. With more intensive development and utilization of former areas, the concentration time of runoffs into the basin has been greatly accelerated. The sluices in the existing Charles River dam were not designed to handle the rapid increases in peak flows and volume that have been and will continue to be experienced.

A number of alternative means of resolving the flood problem in the basin have been considered and are described in Section L, Other Plans Investigated. These include the possibilities of upstream reservoir storage, diversion of flow, perimeter diking measures, flood proofing, and the provision of pumping facilities. However, in view of the rapid storm runoff and filling of the basin that is presently being experienced following heavy rainfalls, control of the water level in the basin through the provision of a pumping station becomes the one positive and economically feasible method of securing desired results during flood periods.

Hydrologic studies were made with various pump capacities varying from 5,600 to 9,800 cfs. The capacities were considered in increments of 1,400 cfs which represents the individual pump size originally planned by the MDC. Utilization of multiples of this pump size will result in project economy due to the advanced stage of design already accomplished by the pump supplier for the MDC. Costs and benefits were derived for all studies. Results are presented graphically on the following chart which shows a curve of excess annual benefits for various pump capacities. The maximization of benefits occurs at about 7,300 cfs, however, the peak of the curve is fairly flat. In order to provide a high degree of flood protection to this intensively developed heavily populated region, the standard project flood (SPF) was used as the design flood in determining pumping requirements. Provision of a pumping capacity up to 8,400 cfs will also (1) provide a high degree of protection should one pump become inoperative at any time and (2) provide some degree of reserve capacity to compensate for further

NUMBER OF PUMPS	4	5	6	7
PUMPING CAPACITY (CFS)	5600	7000	8400	9800



CHARLES RIVER DAM
EXCESS BENEFIT CURVE

urban development and faster runoff in the lower watershed. The following tabulation summarizes basin levels for the SPF with various pump discharges, assuming the predrawn Basin level as follows:

Pump Capacity (cfs)	Basin Elevation in Feet, MDC base	
	Predrawn to 106.5	Predrawn to 107.0
7,000	111.0	111.8
8,400	110.5	111.3
9,800	109.8	110.6

Inundation of surrounding lowlands, highways, and the back-up through sewers and drains into basements begins at elevation 109.5. Significant overland flooding damages begin at about 110.2. Although a pump capacity of 8,400 cfs results in a stage that is 0.3 foot higher when the Basin is predrawn to 106.5 and 1.1 foot higher when it is predrawn to elevation 107.0, the selection of a 6-pump, 8,400 cfs discharge capacity provides the desired protection for the related frequency of flooding. The additional expenditure for another pump is not economically justified.

48. NAVIGATION. - The imminent need and justification for additional locking facilities to improve navigation between the Charles River Basin and Boston Harbor was determined from extensive studies and investigations made by the Corps of Engineers utilizing official records of the Metropolitan District Commission (MDC) who maintain and operate the existing Charles River lock and dam. Charles River navigation occurs principally in the lower 8.6-mile reach from the Watertown Dam to the existing Charles River Dam. Located in this reach are four yacht clubs, nine rowing clubs, two small-boat sailing pavilions, two trailer-boat launching areas and four designated public mooring areas. Water transportation in the lower Charles River is aided by existing Federal navigation project of 35-foot depth which connects with the major ship channels constructed and maintained in Boston Harbor by the Federal Government.

The existing single lock at the Charles River Dam is not adequate for handling the ever-increasing recreational boat traffic and commercial vessel traffic to and from the Charles River Basin without congestion and long delays. The existing locking facilities were completed in 1910 for the increasing commercial traffic and the nominal pleasure craft usage at that time. This trend continued until 1926 when a peak of 7,505 lock passages were made by commercial vessels and approximately 1,400 trips by recreational craft. Since that time, there has been a rapid growth in the numbers of pleasure boats and a gradual decline in commercial vessels using the lock. In 1970, there were 785 passages for commercial vessels and 16,225 for recreational boats based on the records of the MDC.

The existing navigation lock is 45 feet wide and 350 feet long. The sill elevations provide water depth of 18 feet at low water conditions. The lock is equipped with two gates which move horizontally into place from slots in the east wall of the lock. These gates by present-day standards are obsolete and inadequate. Further, the lock has proved insufficient to accommodate recreational boat traffic during peak summer days. Present navigational difficulties will become more pronounced as a result of nominal increase in commercial vessel traffic and rapid and substantial increase in recreational boating expected in future years. While commercial traffic in the basin has been declining for many years, it is now believed to have essentially stabilized. The present traffic involves deliveries of heavy fuel oil to the gas and electric generating facility located on the Broad Canal, Cambridge, about one-half mile above the existing dam. This facility was rebuilt at this location in 1949 and is expected to remain here throughout the navigation project life. Company officials state that oil receipts will probably increase on an average of one to two percent per year. Large deliveries of oil are also made to the terminal facilities of a major oil company on Lechmere Canal in Cambridge, next to the present dam. Receipts of this company are also anticipated to increase at an average one to two percent each year.

Conditions conducive to pleasure boating will improve by reason of (1) a reduction in sewage pollution resulting from the Metropolitan District Commission comprehensive pollution control program, (2) conservation of water surface through the construction of new marinas with individual slips rather than the mooring of boats in open water, (3) new regulations resulting from the improvements regarding the use of the Basin by boats and (4) expanded and improved locking facilities.

The continuing trend toward greater boating activity is expected to result in a substantial increase in the number of pleasure boats in the Basin. At present, there are in excess of 900 power boats based in the Basin, including an equivalent transient trailer fleet of 100 or more boats, which use the lock. It is estimated that this number will expand to 2,550 boats along an accelerated growth curve, during the fifty years after the project is completed.

It is considered that the optimum plan for alleviating the existing and prospective navigation difficulties would be to abandon the existing lock and provide new and larger locking facilities. The needs would be met by two small recreational boat locks, each 200 feet long and 25 feet wide; and a larger lock 300 feet long and 40 feet wide for use by commercial vessels and large recreation craft, and to supplement the small locks on peak days in the summer. The size of the large lock represents a 50-foot reduction in length and a 5-foot reduction in width from the existing structure. These reduction were based on studies of existing and prospective commercial use on the waterway and will provide for all tug-barge combinations without difficulty.

Further, these dimensions will allow proper clearances to prevent damage to vessels by turbulence during filling and emptying the lock. The reduction in width recognizes limitations of 40 feet imposed by upstream bridges located above the reach presently used by commercial vessels.

Studies were made to improve locking facilities at the existing dam. Since the greater part of the top of the dam is now occupied by other structures, lock improvements cannot economically or physically be provided. The best alternative solution is to provide adequate, efficient locking facilities at a new location for increasing commercial and recreational boat traffic.

The new locks, with modern equipment, will afford increased locking capacity and reduced locking time. By eliminating delays, the project will encourage greater use of the locks by the present fleet of recreation boats, including trailered boats and those that will transfer to the basin. The recommended improvement, together with associated measures such as expected new launching sites and marina facilities will foster a growth in the size of the local recreational fleet in the Basin. The MDC will operate and maintain the locking facilities.

49. HIGHWAY TRANSPORTATION. - Studies made by the Metropolitan District Commission indicated that highway transportation facilities could be enhanced by making provisions in the project for a vehicular viaduct spanning over the construction works. In compliance with the requests of local interests, coordinated with the U. S. Bureau of Public Roads, the dam will be designed to support a highway viaduct to be constructed between Boston and Charlestown, over the locks and along the upstream face of the river pumping station. The highway viaduct has been designed to provide additional vehicular access between Charlestown and Boston to relieve the traffic congestion at City Square in Charlestown. Present traffic volume in City Square is over 44,000 vehicles per day. Highway transportation interests will benefit to the extent that economics are effected by designing the new dam to serve as the foundation for a highway viaduct. A needed new highway crossing at this location, without the dam project, would require the construction of either a new drawbridge or a high level highway bridge. The transportation features have been included at the request of the Metropolitan District Commission and it has been established that they will bear all costs allocated to highway transportation.

50. PROJECT FORMULATION. - Construction of the Charles River Dam Project represents the optimum water resources development for the preservation and enhancement of desirable features of the urban environment. The multiple-purpose project, including flood control,

navigation and highway transportation wil replace an antiquated and obsolete lock and dam with a new dam and multiple locking facilities. The pumping plant will provide a solution for the present and rapidly growing flood problems caused by urban development. The additional navigation facilities provided will meet existing and future needs. The highway bridge will improve motor vehicle transportation to and within the City of Boston. Further, the project will provide fish passage facilities as a first step in restoring migratory fish-runs to the Basin. Alternative solutions have been fully explored.

The variation of pumping capacity and number of pumps to be provided in the pumping station was studied and, as previously explained, the total capacity of 8,400 cubic feet per second or six pumps for flood control is required to provide a high degree of protection for the densely urbanized communities adjacent to the lower Charles River Basin. Studies and investigations, including official records of the Metropolitan District Commission, determined that additional and modern locking facilities and replacement of the existing antiquated and obsolete lock will satisfy the imminent need to improve navigation and alleviate boat passage difficulties from the constant increase of recreational boating to and from the Basin. The request of the Metropolitan District Commission for a highway viaduct over the structures and their willingness to bear all costs allocated to highway transportation, in conjunction with investigations made by the Corps of Engineers, concluded that there is need and justification for a new bridge crossing for vehicular access between Charlestown and Boston.

The recommended multiple purpose project is economically justified with a benefit to cost ratio of 1.7 to 1.0 from a national income point of view on the basis of the added benefits in excess of those derived from the existing but obsolete facilities. For each project purpose the average annual benefits exceed the annual separable costs for adding that purpose to the project.

O. CORROSION MITIGATION

51. GENERAL. - The proposed project will be located at the mouth of the Charles River in an area of brackish and salt water. Corrosion is considered to be a serious problem at this site and corrosion mitigation will be required. In order to determine the corrosion characteristics of the area and its effect on the proposed structures, studies and surveys have been made of the water and soil at this site. These studies and surveys also included an inspection of the Mystic River Locks and Dam facility which is similar to the proposed project located in brackish water environment less than 3 miles from the project site. The results of the corrosion study will be included in Design Memorandum No. 7, "Navigation Locks and Facilities".

P. ACCESS ROADS AND PARKING FACILITIES

52. GENERAL. - Since the project will be located in a highly urbanized area, all streets leading to the site are heavily congested with local city traffic. Construction vehicles traveling to and from the site will use these existing city streets. In addition to the city streets, a system of limited expressways is immediately accessible to the site of the project. The existing roads to be used for access to the project site are shown, in part, on Plate 2-2.

53. ACCESS ROADS.

a. Warren Avenue. - During the initial phase of construction, access will be required on the north side of the river to the pumping station, large navigation lock, the fish passage facilities and the left abutment of the dam. This access will be from the existing Warren Avenue in Charlestown. After completion of the permanent works, this street will be reconstructed to provide entry by maintenance vehicles to the multi-purpose facilities and the new parking area.

b. Beverly Street. - The second phase of construction will require access to the site from the south side of the Charles River. This access will be along the existing Beverly Street in Boston and will allow construction access to the small locks, the right abutment of the dam and the highway viaduct. After construction Beverly Street will become a permanent part of the highway viaduct and will also be used for access to parking facilities on the Boston shore and for access by maintenance vehicles to the navigation locks and the right abutment of the dam.

54. PARKING FACILITIES.

a. General. -In connection with the proposed multi-purpose project, parking facilities will be provided on both the north and south sides of the Charles River. These parking areas have been designed primarily for automobile use and as such will be constructed of 3 inches of bituminous concrete on a 12 inch gravel base. The layout of the pavements is shown on Plages 2-12 and 2-13 and typical pavement details are shown on Plate 2-14.

b. Boston. - A parking area consisting of 16 spaces will be provided at the Boston end of the proposed project to accommodate vehicles of operating personnel, visiting officials, and to a limited degree, sight-seers. This parking area is located on the upstream side of the dam with access from the viaduct roadway off Beverly Street. A walkway connecting the parking area to the access road and small boat lock passes under the proposed viaduct for safe passage of operating personnel.

c. Charlestown. - The parking area on the Charlestown side of the Charles River will be an adjunct to a portion of existing Warren Avenue which will remain beneath the proposed viaduct. Access from City Square will be available via Water Street and Waldo Street, but there will not be direct vehicular access from the proposed viaduct because of the grade differential. Existing Warren Avenue will be reconstructed to provide entry to the pumping station and to the new parking area. Visitors will be attracted to the site and thirty-one parking spaces will be provided for this purpose. The fish passage facilities are located near the parking area and the operation can be readily observed from the adjoining plaza.

Q. CONSTRUCTION MATERIALS

55. GENERAL. - The project will require approximately 139,000 cubic yards of granular fill, 60,000 tons of protection stone and 84,000 cubic yards of concrete. Since the project site is located in the downtown part of Boston, there are no available sources of construction materials on the project site. Therefore, all materials will be obtained from commercial sources located within a radius of 25 miles from the site. Location of the sources of the various construction materials are as follows:

a. Granular Fills. - Sources of granular materials are available in the towns of Canton, Foxboro and Marshfield at trucking distances of 16, 20 and 18 miles respectively from the project site.

b. Protection Stone. - The Type III protection stone (cut stone) is economically available from granite quarries in Chelmsford, Massachusetts, which is located approximately 25 miles from the site. The Type I and Type II protection stone, which are run of the quarry materials are economically available from commercial sources located less than 20 miles from the site.

c. Concrete Materials. - Data on concrete materials are contained in Design Memorandum No. 3, approved 11 June 1971.

56. GOVERNMENT-FURNISHED PROPERTY. - In addition to the contractor furnished materials, it is planned to procure 6 - 1,400 cfs river pumps with diesel engines, and all associated equipment by separate Government supply contract and to provide such items as Government-furnished property for incorporation into the work under the general construction contract. A supply contract awarded after approval of this report and formalization of local assurances will permit the longest practical period for the manufacture of the pumping equipment.

R. PUBLIC USE

57. PUBLIC USE. - The type, location, surroundings and functional nature of the Charles River Dam project limits options for public use facilities except those which can be integrated with the project purpose, public safety and operational requirements. To be considered also are the constricted nature of the site, the urban environment and the extremely high land values in the area. Further, natural assets which the public could use to advantage do not exist. However, it is believed the completed project will generate public interest. To accommodate that interest, a parking area will be provided at the northerly side of the facility. It will be possible to walk from that parking area to the plaza at the northerly side of the lock and dam complex. There, the fish passage facilities may be seen and a general view of the locks, dam, appurtenant structures and surrounding environs may be viewed.

S. ENVIRONMENTAL QUALITY

58. ARCHITECTURAL AND ENGINEERING TREATMENT.

a. General. - Architectural design of facilities and structures required for this project will be based upon the development of a harmonious relationship between structures and contiguous visual amenities, including landscaping. The design will provide an aesthetic value and enhance the environment of the urban waterfront site. Locus of the principal structures places them in close proximity to a network of elevated highways and bridges. The complex will become a scenic attribute in an otherwise depressing environment. Nearby structures, in general, lack aesthetic or historical value. A modern architectural concept for this project should be an incentive to improve the entire area. An architect perspective rendition is shown on the following page.

b. Pumping Station. - The predominant structure of the project is the pumping station located at the north side of the locks. Facades, in general, will be of precast concrete peristyle with color anodized aluminum frames and louvers and bronze tinted glass infill. An adjoining plaza will create a small park as a pedestrian way between the visitor's parking area and the pumping station. Located within this area is a depressed planting area with a fish passage observation point provided as a cultural benefit for visitors. Landscape architectural treatment of this area will ease the rigidity of large masses by providing variations in pavement levels, concrete textures, and planting. At the south side of the river, a secondary plaza and parking area will be provided adjacent to the locks. Thus, land approaches to the project will be similar and each will provide an aesthetic preface for visitors as well as termini for a stream-wide enhancement of the environment.

c. Navigation Locks. - The locks and their appurtenances will be simple and functional presenting an attractive appearance by their structural mass and relationship to the other elements of the project.

Two smaller structures are superimposed on the lock walls. One is an elevated control tower which spans the center lock and is supported on concrete piers. The tower will have steel structural framing with cast-in-place concrete facades and bronze tinted glass infill. The other structure is a personnel building for dock hands located between the large lock and small lock No. 2. The facades reflect the columnar style of the pumping station. The structural framing is cast-in-place concrete. Infill between columns is bronze tinted glass and glazed concrete masonry units.

d. Highway Viaduct. - A highway viaduct passes over the locks and forebay area of the pumping station. The viaduct structure will be constructed with concrete piers, structural steel deck framing, concrete deck, with concrete aluminum rails. The viaduct forms a graceful arc across the upstream approach to the development. Concrete finish for the viaduct will be similar to other cast-in-place concrete masses to effect a visual consolidation.

e. Landscape Planting. - Opportunity for landscape planting is limited. However, full use will be made of plant material to soften architectural lines, enhance the project area and provide visual amenities.

59. ENVIRONMENTAL IMPACT. - The project will enhance the aesthetic and recreational potential of the area, provide a flood free environment, eliminate extensive flood losses, provide improved vehicular and boat traffic flows, enhance water quality to the Charles River Basin and improve fish passage. A detailed five-point statement of the impact the project will have on the environment was prepared as required by Section 102 (2) (c) of the National Environmental Policy Act of 1969. The final environmental statement for this project was filed with the Council on Environmental Quality August 15, 1971.

CHARLES RIVER LOCKS AND DAM

T. REAL ESTATE REQUIREMENTS

60. LOCATION AND PROPERTY DESCRIPTION. - The project will span the Charles River at a point along Warren Avenue, between the North End and Charlestown areas of Boston. Properties within the project area that are subject to acquisition are identified as follows:

a. Parcels 1 and 2. - These parcels are partial takings from a property located on the south side of the Charles River, northwest of Beverly Street and owned by the 150 Trust, Robert C. Linnell and Russell D. Cox, Trustees. These two contiguous parcels of land are situated in an industrial zoned district. The maximum permitted structure height is restricted to 155 feet; however, the parcels are subject to the existing Expressway easements for the elevated highway. The highway easement restricts the height clearance to approximately 26 feet. Parcel 1 contains approximately 35,225 square feet of irregularly shaped land lying between the United States Pierhead and Bulkhead Line and the southerly shore of the high water line of the Charles River. This area is only partially under water due to recent filling operations between the bulkhead and shore lines. It is subject to the John F. Fitzgerald Expressway easements for both the elevated highway and drainage systems. Parcel 2 contains about 31,595 square feet of land. The parcel is served by spur trackage and the ownership is also subject to the John F. Fitzgerald Expressway easement for the elevated highway. It is also subject to the rights enjoyed by the Boston and Maine and Union Freight Railroads use for spur track purposes. Parcel 1 is to be acquired in its entirety. A small portion has been filled and the remainder is tideland. The cost to fill and erect a bulkhead to utilize the tideland area for any commercial purpose is considered to be economically infeasible. Parcel 2 is currently utilized as a commercial parking area due to the overhead highway restrictive easements which limits its use. Knowing that the North Station industrial complex enjoys above adequate open unobstructed parking areas that are easily accessible from Nashua Street, Beverly Avenue and Accolon Way, and that Parcels 1 and 2 are encumbered by easement to the City of Boston for drainage rights and the Commonwealth's highway and drainage easements, then it is the considered opinion that no severance damages to the industrial complex will occur as a result of the taking. The diminution in fair market value to the entire North Station complex, as a result of the taking of Parcels 1 and 2, is that of the value of the land to be acquired. The remainder of the 150 Trusts' property is sufficient in area to support the normal operation of the North Station complex. The result of the taking of the irregularly shaped parcels will not cause any appreciable distortion in shape of the remaining land.

b. Parcel 3. - This parcel contains approximately 49,442 square feet of land located on the northerly side of the United States Pierhead and Bulkhead line along the Charles River, at a point west of and immediately adjacent to Warren Avenue in Charlestown, Massachusetts.

It is owned by the Boston Redevelopment Authority. The proposed taking area consists of the entire tract and includes filled land, a granite sea wall, tideland, and pile and platform supported land. An inspection of the parcel revealed that a portion of the low studded pier supported platform has deteriorated, causing a void on the surface near the granite sea wall. This void has been filled recently with concrete. A large portion of the subject has a gravel fill over the pile supported platform to an approximate average depth of five feet. The most southeasterly corner of the parcel reveals fractures and deterioration to the retaining wall near Warren Avenue where the so-called pile supported wooden platform can be observed. About 2,300 square feet of the total area considered for acquisition lies in the Charles River forward of the granite retaining wall at the southerly boundary. There are about 47,142 square feet of usable surface area in this parcel. The improvements upon this parcel are limited to a portion of an old one story Boston and Maine freight house area that have been demolished to facilitate construction for the complex of overhead highways which are now under construction. About 90% of the building area of this structure lies upon land owned by others. The remaining portion of the structure that is located upon the subject parcel lends little, if any, economic value to the site. The highest and best use of this parcel is considered to be for industrial development. The present use is that of random truck and automobile parking. There is an adequate approach to this parcel from Warren Avenue. It is encumbered by an access road easement in favor of the Boston Sand and Gravel Company and the Boston and Maine railroad. The easement is 30 feet in width and affords a vehicular route for the Boston Sand and Gravel Company from Warren Avenue to their main plant. The tract is further encumbered by another easement enjoyed by the Boston and Maine Railroad Company for purposes of locating a spur railroad track for service to the nearby Charlestown Navy Yard. It consists of a strip of land measuring 20 feet in width and running in a northeasterly direction over the northerly portion of this parcel. The easement is also enjoyed by the Department of Public Works of the Commonwealth of Massachusetts to locate crossings over, on, or under said area in any manner. The recently installed Navy Yard Spur track is at approximate grade level on this parcel, permitting minimum effort to establish convenient grade crossings.

c. Parcel 4. - Parcel 4 contains 5,241 square feet of tidelands with improvements building upon piles and a dock platform over the Charles River flats. The property is located on the easterly side of a dead end street known as Charles River Avenue, and bounded on the south by the United States Pierhead Line of the Charles River in Charlestown, and owned by Rapids Realty Inc. The area is zoned as an Industrial District. The maximum permitted building height is 155 feet. The proposed acquisition involves the taking of a portion of a two-story wooden framed asbestos covered warehouse and docking facilities. The proposed taking area represents approximately 10% of the total warehouse which is utilized for furniture storage. Severance damages are predicated upon the loss of proportionate storage space, and the construction of an end wall to the

building after removal of the pilings and dockage located in the taking area. Severance damages are estimated at $25,000 in addition to the cost of erecting a new end wall. The costs of construction work for this end wall section is estimated at $17,000. Therefore, total severance damage is estimated at $42,000.

d. Parcels 5 through 8. - These parcels are located on the easterly side of Warren Avenue, Charlestown, Massachusetts. The parcels are contiguous to one another, being bounded on the south by the United States Pierhead Line along the northerly side of the Charles River and owned by Annette George. The area is zoned as an Industrial District with a maximum permitted building height of 155 feet. The proposed taking area consists of 69,246 square feet of land, piles and platform, dock area, and flats. There are no improvements on the subject land. Parcels 5 and 6 are Land Court titles, containing 13,863 square feet and 6,068 square feet of land, respectively. Parcels 7 and 8, containing 4,485 square feet and 44,830 square feet respectively, are areas which are occupied under permit for rights and privileges to install wharves, piles and fill. The existing wood pilings, platform, and dock area are in poor physical condition. Several areas of the asphalt pavement within the described area have become deteriorated, exposing rot and decay to the pile supported wood platform. Their physical condition is considered to be unsafe for use as was originally intended. Parcel 5 enjoys frontage on Warren Avenue and Waldo Street. About 12,763 square feet of this parcel is good solid land lending itself to easy industrial development.

e. Parcels A & B. - Parcels "A" and "B" are partial takings from the Boston and Maine Freight Yards located on the north side of the Charles River and west of Warren Avenue, and owned by the Boston and Maine Railroad Company. This area is zoned as an Industrial District. The maximum building height is 155 feet. Parcel "A", a proposed Temporary Construction Easement, contains 27,860 square feet of irregularly shaped land. It is situated immediately adjacent to the westerly boundary line of Parcel 3 and just north of the United States Pierhead and Bulkhead Line. This parcel is subject to a 30-foot wide, right of way easement, which runs in a southwesterly direction through the entire parcel. It is also subject to the John F. Fitzgerald elevated expressway highway easement, and its use is restricted by the foundations and supports for the highway. There is about 40 feet of headroom clearance beneath the highway structure. The highest and best use of Parcel "A" is that of vehicular parking and freight storage areas in conjunction with contiguous land areas owned by the Boston and Maine Railroad Company. The total area of Parcel "A" is 27,860 square feet of filled land, of which about 2,000 square feet of the area lies forward of the granite sea wall in the Charles River, hence about 25,860 square feet of area can be considered usable.

Parcel "B", a proposed Temporary Construction Easement, contains 41,000 square feet of irregularly shaped land, situated immediately adjacent to the westerly boundary line of Parcel "A", and on the northerly shore line of the Charles River. This parcel is contiguous to Parcel "A" and encumbered by the same easements. The highest and best use of Parcel "B" is that of vehicular parking, freight storage, and limited industrial development in conjunction with contiguous land areas owned by the Boston and Maine Railroad Company. The total area of Parcel "B" is 41,000 square feet, of which about 1,000 square feet of the area lie forward of the granite sea wall in the Charles River, hence about 40,000 square feet of the area can be considered usable. Parcels "A" and "B" reflect comparable land values which are predicated upon recent land sales in the immediate area. It is reasonable to assume that the market value is reflected at $1.00 per square foot. These particular parcels are subject to easements and numerous concrete and steel supports for the overhead highways. Due to the permanent obstacles and easements, the subjects have less value than that value of more accessible, unrestricted and unobstructed lands in the area. Predicated upon a fair return of invested capital and an allowance for a real estate tax expense for the use of the owner's land for Temporary Construction easements for a four-year period are estimated as follows:

Construction Easements	65,860 Square Feet
Value Per Square Foot	$1.00
Estimated Fee Value	$65,860.00
Fair Return & Economic Tax @ 10%	$6,586 Per Annum

The four year use of the appraised area of land is estimated as follows:

4 Years X $6,586 Per Annum	$26,344

Land area forward of sea wall in Charles River, considered to be a limited use area, has an estimated fee value of $0.10 per square foot.

3,000 square feet X $0.10 Per Square Foot	$ 300.
Fair Return & Exonomic Tax @ 10%	30.

Therefore the four-year use of the tidelands' fair market value is estimated at $120.

65,860 Square Feet Usable Area	$26,344.
3,000 Square Feet Tidelands	120.
TOTAL FOUR-YEAR RENTAL VALUE	$26,464.

NOTE:

The Boston Sand and Gravel access road has not been in use during the development and construction of the John F. Fitzgerald overhead highway and the new northeast overhead expressway. The area beneath these overhead highways has been utilized for storage of construction equipment and construction work, including excavation and installation of foundations and piers for the highways. An alternate route for use of the Boston Sand and Gravel vehicle is now in use by the Company. It begins at a point near Prison Point Bridge and runs to Front Street in the same northerly direction as that of the prior used 30-foot access road. This new route for Boston Sand and Gravel is a benefit in that no railroad track crossings or elevated highway support column obstacles have to be contended with.

61. HIGHEST AND BEST USE. - The respective Parcels 1, 2, and 4 are utilized to their highest and best use, contingent upon encumbrances. The highest and best use for Parcel 3 is considered to be for industrial development. Parcels 5, 6, 7, and 8 which are presently unimproved, have a highest and best use for permitted industrial development.

62. UTILITIES AND SERVICES. - The general area of all parcels involved is conducive to City of Boston utilities and services.

63. RECOMMENDED ESTATES TO BE ACQUIRED. - Partial takings from two ownerships for Parcels 1, 2 and 4 will be required. Parcels 3, 5, 6, 7 and 8 from three ownerships will be acquired in full. It is recommended that real estate interests be acquired in fee on these properties. Parcel "A" and "B" are categorized as temporary construction easements.

64. SEVERANCE DAMAGES. - Severance damages have been predicated upon the loss in value of the remainders of the individually affected parcels, and are estimated at $42,000.

65. ACQUISITION COSTS. - Local interests will provide all lands, easements and rights of way necessary for construction of the project. Based upon experience of this office, costs of acquisition, which include mapping and surveys, legal descriptions, title evidence, negotiations, closing and administrative costs for condemnation, are estimated at $15,000 for the five ownerships which encompass ten separate tracts.

66. RESETTLEMENT COSTS. - Public Law 91-646 Uniform Relocation Assistance and Real Property Act of 1970, which provides a uniform and equitable treatment of persons displaced from their homes, businesses and farms by Federal and Federally assisted programs in accordance with this law, an estimate of $19,000 is included in this report to cover payments of expense incidental to the transfer of real property.

67. ASSUMPTIONS AND LIMITING CONDITIONS. - Interests to be acquired will normally be exclusive of the bed and banks of the stream beyond the United States Pierhead and Bulkhead Line, which is the limit of the existing navigation servitude. It is assumed that areas required for temporary easements will be restored to reasonable present conditions following construction of the project.

68. CONTIGENCIES. - A contingency allowance of 20% is considered reasonable to provide for possible adjustments or refinements of the taking lines or additional ownerships which may develop, for adverse condemnation awards, and to allow for actual practical and realistic negotiations.

69. EVALUATION. - Estimated values are contingent on review of detailed appraisals prepared by James D. Henderson & Son, Inc., and John F. Murphy of Boston, Massachusetts, as of 1964-1965. To further complement these reports in updating values to the present, additional current comparable sales were obtained, considered, analyzed and interpreted to reflect recent market value data. Estimated values utilized in this report are assigned on the merit of the individual parcels and their contribution to utility in arriving at Fair Market Value. Temporary easement values are predicated upon a fair return of capital invested and is based on the estimated market value of the property, and real estate tax expenses and are computed on an annual basis.

70. ESTIMATED VALUE. -

Land

Fee Taking

Filled Land	80,737	Square Feet @ $2 Per Square Foot	$161,474
Solid Land	12,763	Square Feet @ $3 Per Square Foot	38,289
Pile & Platform	32,458	Square Feet @ $1 Per Square Foot	32,458
River Flats	64,791	Square Feet @ $0.10 Per Square Foot	6,479
Totals	190,749	Square Feet	$238,700

Temporary Easements 4 Year @ 10% Per Annum

Usable Area	65,860	Sq. Ft. @ $1.00 Per Sq. Ft.	$64,860	
	$65,860	X 10% X 4		$26,344
River Flats	3,000	Sq. Ft. @ $0.10 Per Sq.Ft.	300	
	$300	X 10% X 4		120
Total				$ 26,464
Total Estimate of Land Costs				$265,164
Rounded To				$265,000

71. COST SUMMARY. -

Land	$265,000
Severance Damages	42,000
Resettlement Costs	19,000
Contingencies (20% of Above)	65,200
Acquisition Costs	15,000
Total Real Estate Costs	$406,200
Rounded To	$400,000

U. RELOCATIONS

72. GENERAL. - The multi-purpose project will necessitate the relocation of utilities, power supply lines and the extension of the Boston and Cambridge marginal conduits from the present outfalls below the existing dam to a new outfall on the tide side of the new dam. This project will also require the Boston and Charlestown combined sewer overflows into the Charles River between the existing dam and the proposed project be collected by relief sewers and discharged into the Boston marginal conduit system. The design of the relief sewers, the marginal conduits and the sewerage pumping station is currently being accomplished by non-Federal interests.

73. UTILITY RELOCATIONS.

a. Gas Lines. - There is an abandoned 3-inch gas line along the west side of Warren Avenue. This line will be removed as necessary for construction. A 42-inch submarine transmission main east of the Charlestown Bridge, which supplies most of the city of Boston, is within the limits of construction as shown on Plate 2-15. Relocation of this main will not be necessary since it is founded at a depth of 18 feet below the planned dredging limit of elevation 75 feet, MDC base.

The fender piles for the portion of the large lock fender system located over this main will be spaced in a manner to avoid damage to the main.

b. Water Lines. - The abandoned 20-inch water line across the demolished Warren Avenue Bridge will be replaced with approximately 700 feet of two 12-inch water lines supported under the new viaduct. These lines will be connected to the 20-inch line in Boston and Charlestown. In addition, other water mains varying in size from 6 inches to 16 inches and totaling approximately 500 feet in length will be relocated. About 300 feet of these lines are located in Charlestown with the remainder in Boston. The estimated cost for relocations of water lines is $46,000. All water line relocations are shown on Plates 2-12 and 2-13.

c. Sewer and Storm Drainage. - The project will require relocation of approximately 100 feet of 12-inch diameter reinforced concrete (R.C.) pipe and 165 feet of 6-inch cast iron pipe to collect and drain storm water runoff. Additionally, 400 feet of 36-inch diameter R.C. pipe must be relocated in Charlestown to connect existing combined sewers in that area to a new outfall downstream of the pumping station. The estimated cost of the sewer and storm drainage relocations is $42,000. The proposed project will also require adjustments to drainage facilities on the Millers River when the dam is constructed and

the basin is extended downstream to the new dam. This work is estimated to cost $12,000. Locations and extensions of required sewer and storm drainage work are shown on Plates 2-12 and 2-13.

d. Marginal Conduit System. - In connection with this project, non-Federal interests are required to relocate all combined storm and sewer flows that presently discharge below the existing dam to a new discharge outlet below the new dam to eliminate pollution flows into the basin formed between the two dams. This relocation work, which is currently under contract by the Metropolitan District Commission to a consultant engineering firm, consists of the following:

(1) Relief Sewers, Charlestown and Boston Overflows.

(a) 1500 linear feet of 7-foot diameter conduit at an estimated cost of $750,000.

(b) 50 linear feet of a subaqueous crossing of Millers River at an estimated cost of $50,000.

(c) 80 linear feet of 5-foot diameter conduit to collect the combination overflows at an estimated cost of $32,000.

(d) 1600 linear feet of 5-foot diameter conduit connecting the Metropolitan sewer to the marginal conduit system at an estimated cost of $640,000.

(e) Lowell Street connector at an estimated cost of $193,000.

(f) Special chamber work at an estimated cost of $15,500.

(2) Boston Marginal Conduit. - This consists of 2300 linear feet of a 90-inch diameter reinforced concrete force main from a new Sewerage Pumping Station to a new outfall below the project. Included with the dam will be 280 feet of this force main. The remaining 2020 feet will be constructed by non-Federal interests at an estimated cost of $1,212,000.

(3) Cambridge Marginal Conduit. - Approximately 1350 linear feet of 7-foot diameter subaqueous force main will be installed to connect the Cambridge marginal conduit system and the Charlestown relief sewer overflows to the new sewerage pumping station for discharge through the Boston marginal conduit to the harbor below the new dam. The estimated cost of this work is $1,485,000.

(4) Sewerage Pumping Station. - In order to provide sufficient pumping capacity to discharge flows from the Cambridge marginal conduit,

the pumping station currently planned for construction just below the existing dam will be enlarged. The estimated cost to provide for the additional capacity is $1,000,000.

e. Electric. - Except for relocations in connection with the Massachusetts Bay Transit Authority system, no other electric relocations are required. Abandoned submarine cables and ducts under the Charlestown Bridge and three electric light poles in the construction area are to be removed. The Massachusetts Bay Transit Authority (MBTA) facilities, under the Charlestown Bridge consist of 5 A.C. Cables, 5 D.C. Cables, 5 return Cables, 1 D.C. motor feed, 2 air pipes, 3 telephone cables and 3 signal cables. These facilities are within the limits of required dredging and therefore must be relocated. It is expected that these facilities will be relocated through the new MBTA tunnel located just upstream of the proposed dam. The estimated cost of these relocations is $134,000.

f. Telephone Lines. - Although no telephone line relocations are required, the viaduct has been designed to permit the installation of 22 4-inch transite ducts by the telephone company. This duct system will connect to existing systems in Charlestown and Boston.

g. Fire and Police Alarm Systems. - No fire alarm relocations are necessary; however, the Boston police signal box on Warren Avenue in Charlestown will be relocated approximately 100 feet to the north.

h. Oil Line. - A 6-inch oil supply line is located in Beverly Street, Boston. This line supplies the Boston Edison Company Plant in Charlestown and is carried over the Charles River on the John F. Fitzgerald Bridge located just upstream of the project. Relocation of this line is not necessary but it must be protected during construction operations.

i. Railroad Relocations. - A section of railroad trackage operated by the Boston and Maine Railroad and located on the Boston shore crosses a small portion of land near which parking facilities are planned. The estimated cost of this track relocation is $4,000.

j. Total Estimated Cost of Relocations. - The total cost of all relocation work, including contingencies, engineering and design and supervision and administration is estimated at $7,100,000.

V. COST ESTIMATES

74. FIRST COSTS.- Unit prices used in estimating construction and relocation costs are based on average bid prices for similar work in the same general region, adjusted to the 1971 price level. Valuations of real estate are based on recent appraisals of properties at the site

and includes the additional costs for resettlement and acquisition as required under the recently enacted Public Law 91-646. All construction costs include an allowance of 11 percent for contingencies which reflects the advanced stage of design for this project. The total first cost of the project is estimated at $37,800,000. A summary of the costs of the various features of the work is given in Table 2 and a detailed breakdown of quantities and unit prices is included in Appendix B.

TABLE 2

SUMMARY OF PROJECT COSTS
(June 1971 Price level)

Project Features	Estimated Cost
Land and Damages	$ 400,000
Relocations	7,100,000
Dam	1,600,000
Navigation Locks	13,500,000
Bridges (Viaduct)	800,000
Pumping Station	11,000,000
Engineering and Design	1,400,000
Supervision and Administration	2,000,000
Total Estimated First Costs	$37,800,000

75. COMPARISON OF ESTIMATES. - The current cost estimate of $37,800,000 reflects an increase of $200,000 since the last reported estimate in the PB-3 of 1 July 1971 which amounted to $37,600,000. Table 3 outlines and explains the changes.

TABLE 3

COMPARISON OF ESTIMATES

Project Feature	Project Authorization	PB-3(1971)	Current	Change
Lands and Damages	$ 400,000	$ 530,000	$ 400,000	-$ 130,000
Relocations	3,300,000	6,100,000	7,100,000	+ 1,000,000
Dam	1,200,000	1,600,000	1,600,000	0
Navigation Locks	9,600,000	13,040,000	13,500,000	+ 460,000
Bridges (Viaduct)	1,100,000	1,480,000	800,000	- 680,000
Pumping Station	8,600,000	11,750,000	11,000,000	- 750,000
Engineering & Design	800,000	1,150,000	1,400,000	+ 250,000
Supervision & Administration	1,600,000	1,950,000	2,000,000	+ 50,000
TOTAL COST	$ 26,500,000	$ 37,600,000(1)	$ 37,800,000(2)	+$ 200,000

(1) Except for relocations, the increases in construction features between the authorization and the PB-3(1971) were due to price escalation. The increase in relocations was based on preliminary estimates furnished by the Massachusetts Metropolitan District Commission.

(2) Changes are due to adjustments of the project cost estimate to reflect more appropriate allocated costs to project features and a more detailed estimate for relocations. The decrease for lands is due to current appraisals and the increase in Engineering and Design and Supervision and Administration is due to re-analysis of requirements based on design effort to date.

W. SCHEDULES FOR DESIGN AND CONSTRUCTION

76. DESIGN. - Preparation of contract plans and specifications for construction of the project will be accomplished during Fiscal Year 1972 and the early part of FY 1973 with a completion date scheduled for September 1972. Design plans and specifications for the construction of the sewerage pumping station, Boston and Cambridge marginal conduits, sewer and drainage facilities and utility relocations, are being prepared by the Metropolitan District Commission, Commonwealth of Massachusetts. This work estimated to cost about $14,000,000, is scheduled to be accomplished concurrently with the recommended project. A separate Government supply contract for design and fabrication of the six river pumps and associated equipment is scheduled for award in May 1972.

77. CONSTRUCTION. - It is estimated that 3-1/2 years will be required for construction of the project. During this same time, the Metropolitan District Commission, will accomplish the construction of the sewerage pumping station, marginal conduits and other combined sewer overflow systems in order that these relocations will be operational at the same time that project construction is completed. All construction, except for the fabrication of pumps and associated equipment, will be accomplished under a single continuing contract to be advertised and awarded in FY 1973. The separate contract for furnishing pumps and auxiliaries will afford the longest, practical period for their manufacture. An estimated construction schedule follows:

a. Fiscal Year 1973. During the first year, the contractor will mobilize, clear the construction area of the abandoned ruins of the Warren Avenue bridge and bridge foundation piling, remove all existing facilities, dredge the river bottom material, install the stage one cofferdam and excavate the temporary bypass channel. All required excavation inside the stage one cofferdam will be accomplished. Concrete work will be initiated for the pumping station, large navigation lock, fish passage and sluice facilities and retaining walls. Utility relocations will be performed concurrently with the above work.

b. Fiscal Year 1974. The contractor will continue placing concrete for the structures inside the cofferdam and will construct the earth dam between the pumping station and the left abutment (Charlestown shore). In addition, the contractor will initiate installation of major equipment and auxiliaries in the pumping station, large navigation lock and appurtenant structures and begin construction of the fender system and other marine works.

c. Fiscal Year 1975. Installation of major equipment, pumps and auxiliaries and construction work within the stage one cofferdam will be completed. The large navigation lock will be put into use for the passing of boats as the stage one cofferdam is removed and the stage two cofferdam installed. Required excavation, preparation of the foundation and placing of the concrete within the stage two cofferdam will be started. The construction of viaduct piers on the Charlestown shore and on the river structures will be accomplished. The pumping station superstructure and large navigation lock including the personnel building, will be completed and all land work on the Charlestown shore will be accomplished. The dam embankment and required rock protection to the right abutment (Boston shore) will be completed and work on the viaduct abutment and pier foundations to the Boston shore will be started.

d. Fiscal Year 1976. The contractor will complete the small locks and remove the stage two cofferdam. Construction of the control tower over the locks and the highway viaduct will be completed. The remainder of the fender systems and marine work will be finished along with stone protection, roadwork, landscaping and paving. The contractor will perform all testing of operational features of the project and accomplish final cleanup operations to complete all work at the project site.

78. FUNDS REQUIRED. - The construction schedule is based on funding of $3,000,000 in Fiscal Year 1973 to advertise and award a multi-component continuing contract to start the construction works and additional funding appropriated in ensuing years as required. Further, the schedule is based on non-Federal interests complying with the requirements of local cooperation which will be included in the formal assurances. Accordingly, it is estimated that funds will be required as follows:

	Federal	Non-Federal	Total
Est. Obligations thru FY 72	$ 1,193,400(1)	-	$ 1,193,400
FY 73 (Award Constr.Contract)	3,000,000	$ 1,638,000	$ 4,638,000
FY 74 (Continue Constr.)	7,845,000	4,355,000	12,200,000
FY 75 (Continue Constr.)	7,920.000	3,830,000	11,750,000
FY 76 (Complete Constr.)	4,796,600	3,222,000	8,018,600
TOTAL PROJECT FIRST COST	$24,755,000	$13,045,000(2)	$37,800,000

(1) Includes $400,000 obligated for fabrication and delivery of pumps.

(2) Includes $5,545,000 cash contribution and $7,500,000 for lands and damages and relocations to be accomplished by non-Federal interests.

X. OPERATION AND MAINTENANCE

79. GENERAL. - The recommended improvement is a local flood protection project and operation and maintenance of all features of the construction works is the responsibility of non-Federal interests; namely, the Massachusetts Metropolitan District Commission. Local interests will operate and maintain the project after its completion, in accordance with regulations prescribed by the Secretary of the Army and the project Operation and Maintenance Manual.

80. OPERATIONS. - The basin impounded by the dam will be regulated for flood control by the Metropolitan District Commission (MDC). Regulation procedures and details are outlined in Section Y, of this report. The MDC staff will consist of an assistant superintendent, 2 electricians, and 2 diesel engine operators, each working a 40-hour week and 5 navigation lock crews. The navigation lock crews will consist of 1 head operator, 1 operator and 2 assistant operators. The five crews of operators are required to insure 24-hour coverage 7 days a week. All personnel except the assistant superintendent will be expected to perform maintenance work in addition to their primary duties.

81. MAINTENANCE. - Semi-annual inspections will be made by the Corps of Engineers of the structures and equipment. Maintenance will be based on regular detailed inspection by the MDC of the entire works including all operations necessary to preserve the structures. Each of the six flood control pumps will be test-operated at least once monthly. Once a year all pumps will be operated simultaneously to remove all sediment from suctions and discharges of the pumping station.

82. MAJOR REPLACEMENTS. - Items deemed to have a usable life less than 100 years for the flood control features of the project and less than 50 years for the navigation and highway transportation features, will be replaced by non-Federal interests when necessary.

83. ADMINISTRATIVE FACILITIES. - Owing to the need for 24-hour operation, a personnel building will be provided on the large lock wall next to small lock number 2. All waste water facilities will be connected to the existing municipal facilities. Locker room facilities will be provided in the gallery section of the large lock. The personnel building will also provide the required office space. A floor plan is shown on Plate 2-10.

84. ANNUAL COSTS. - The estimated annual cost of operation and maintenance is $300,000 and for major replacements in $17,000. All costs will be borne by non-Federal interests.

Y. REGULATION PROCEDURES

85. GENERAL. - The Metropolitan District Commission will operate the project in a manner that will satisfy the following objectives: (a) maintain the level of the basin at 108 feet, MDC base, during normal (nonflood) periods, (b) keep the basin level below damage stage during flood periods, (c) serve the navigation interests of the basin, and (d) assist in the passage of anadromous fish during spawning periods. An Operation and Maintenance Manual will be published and copies provided to non-Federal interests.

86. NORMAL (NONFLOOD) PERIODS. - The desired basin level of 108 feet, MDC base, will be maintained by discharging the fresh water flow through either one or both of the two 8 x 10 foot sluice gates. These gates will be opened as needed when the harbor elevation is below the basin level, which occurs about 7.5 hours on a mean tide cycle. The lower sluice will be opened initially to withdraw the heavier salt water which may be present.

87. FLOOD PERIODS.

a. General. For purposes of regulation, a flood period occurs when the basin level cannot be maintained approximately in a normal range between elevations 107.5 and 108.5 feet, MDC base, by use of the gravity sluice gates only. During flood periods the project will be operated to keep the basin level from rising above elevation 109.5 feet at which level flooding of adjacent lowlands and roadways begins. However, significant damage begins above elevation 110.2.

b. Regulation Procedures. Regulation during flood periods shall be accomplished by any or all of the following procedures, depending on the severity of the flood:

(1) Use of the 2 sluice gates when harbor elevation is below basin level.

(2) Use of any or all of the 6 pumps.

(3) Use of any or all 3 navigation locks or the fish lock for sluicing purposes during extreme flood conditions.

(4) At times when significant and rapid storm runoff are anticipated the basin will be prelowered to elevation 107.0 feet, and in extreme cases further lowered to elevation 106.5 feet when flows approaching design capacity are expected from the lower urban watershed.

88. NAVIGATION.

a. Normal Operations. The two small boat locks will be operated solely for recreational craft. The large boat lock will accommodate commercial traffic and deep draft recreational craft. The large lock will also be used to relieve congestion at the smaller locks during periods of heavy traffic. During periods of high tide, lock pumps will be used to lower the lock level down to basin level. The lock pumps will draw from the lower portion of the lock, pumping into the harbor, thereby minimizing salt or brackish water intrusion.

b. Flood Operations. During flood periods when the rate of pumping and gravity sluicing is high, navigation would have to be curtailed due to high channel velocities, especially at the existing lock. Interference with commercial vessel traffic and pleasure boat traffic occurs when velocities reach about 1-foot per second and 2-feet per second, respectively. These conditions occur with discharges of 1,500 cubic feet per second and 3,000 cubic feet per second, respectively.

89. FISH PASSAGE FACILITIES. - The fish passage facilities will be operated by MDC personnel during daylight hours between 15 April and 15 June for upstream migrating fish. During the remainder of the year the facilities will be available for use as a gravity sluice in conjunction with the other two sluice gates for controlling the basin level.

Z. HEALTH CONTROL

90. GENERAL. - Studies and reports made by the U.S. Department of the Interior, Federal Water Pollution Administration, Northeast Water Quality Management Center provided information on the present water supply and water quality of the lower Charles River below Moody Street Dam in Waltham. The report indicates that there is gross bacterial pollution evident in the lower Charles River. High concentrations of total and fecal coliform organisms found demonstrate that large quantities of sewage are added to the river. In addition, salmonella typhimurium, an intestinal organism pathogenic to man, was isolated from the river and is further proof of the unwholesomeness of the Charles River Basin from a bacteriological standpoint.

91. POLLUTION ABATEMENT. - During the past several years the Metropolitan District Commission has embarked on a program of sewage abatement by providing relief sewers to reduce the quantity and frequency of overflows to the Charles River. Construction or some of the facilities have already substantially reduced sewage flows into the Basin.

In connection with this abatement program, complete engineering studies of the sewage overflows into the Basin and into the harbor below the existing dam are currently in progress by the MDC. The studies and the design plans and specifications will be completed within a year with construction of required facilities to follow shortly thereafter.

92. FLOOD CONTROL FACILITIES. - Completion of the flood control facilities will further improve the health control aspects of the river. As stated in Exhibit 11, Appendix A, the prevention of flood damages will reduce the occurrence of mud and debris, the creation of conditions conducive to rodent infestation and eliminate the displacement of people.

AA. POLLUTION CONTROL

93. GENERAL. - The project when completed will generate no pollution source requiring control measures. Improvement of water quality in the impoundment area will be a beneficial result of the project. This improvement will result from:

a. A reduction of salt water intrusion into the impoundment area will result from operation of the low level sluices which will withdraw the heavier salt water accumulated at the bottom of the Basin. Further, when the tidewater level is above the Basin level, excess water from the locks will be pumped to tidewater through the lock system thereby reducing the volume of salt water passing the locks. In addition, the sector gates are designed to act more rapidly and in sequence, thus reducing the amount of salt water instrusion.

b. Sewers now discharge into the Charles River downstream of the existing dam. The Metropolitan District Commission currently has under design the means for the collection,treatment and disposal of combined sewage and storm drains so that pollution of the lower basin and harbor from this source will be prevented. Long range plans by the Metropolitan District Commission include provisions for disposal of sewage now polluting the upper Charles River. All endeavor by other agencies related to pollution by sewage in the project environs will have the full cooperation of the Corps of Engineers.

94. SOURCES OF POLLUTION. - During construction of the project, water, air and noise pollution are possible from the following sources:

a. Soil erosion.

b. Dust.

c. Clearing.

d. Dredge materials.

e. Spill from batch plant.

f. Waste concrete.

g. Operation of motorized equipment.

h. Oil and fuel spillage.

i. Contractor storage and equipment maintenance areas.

j. Personnel sanitation facilities.

95. POLLUTION CONTROL MEASURES.

a. Soil Erosion. Because the site is located on a flat area in an urban environment, no critical problem of soil erosion exists here. However, during construction operations, the minor surface runoff will be controlled to prevent any discharge of water-borne silt or debris into the Charles River.

b. Dust. Since dust can become a pollution problem, especially in dry weather, a program making use of water and dust palliatives will be enforced on the project.

c. Removal of Existing Wood Structures and Foundations. The usual pollution problem related to this type clearing arises from burning. No burning of material will be allowed on this project. Instead, all debris will be disposed of in land disposal areas off the project site.

d. Dredge Materials. As part of this project, dredging of the highly organic river bottom materials will be required. The criteria recently adopted by the Environmental Protection Agency to determine the acceptability of materials for open water disposal will be utilized. Either open water or land disposal areas will be coordinated with the Environmental Protection Agency based on sediment analyses.

e. Spill from Batch Plant. Since some spillage of materials can normally be expected from batch plant operation, whether aggregate, cement, water, or concrete, it is recognized that a method of control of such materials will be necessary in order to prevent them

from entering the river. A regular cleanup operation will be instituted to control any spillage.

f. Waste Concrete. It is normal that some concrete will have to be wasted because of substandard quality, plant breakdown, or excess. Disposal of such materials will be directed to waste disposal areas.

g. Operation of Motorized Equipment. Pollution by noise and exhaust emissions is to be expected from operation of equipment. In order to minimize such pollution, a continuing program will be in effect during construction to insure that all engines are properly tuned, that effective mufflers are installed in all equipment, and that correct grades of fuel are used in the engines.

h. Oil and Fuel Spillage. All necessary precautions will be taken to insure that oil and fuel are not disposed of carelessly, and to insure that the river and/or ground is not polluted by these agents. A strict policy will be enforced requiring that all major equipment and maintenance be performed in a predetermined location, that all used oils be placed in containers for proper disposal, and that fuel and oil spillage on the ground be kept to a minimum.

i. Contractor Storage and Equipment Maintenance Areas. The locations of these areas will be designated by the Government. Grading and drainage will be controlled to prevent surface runoff from carrying pollutants and debris into the river. A policy of dust control will be enforced.

j. Personnel Sanitation Facilities. Strict sanitation measures will be enforced. The contractor will be required to construct facilities for sanitation and for proper disposal of sewage. As needed, portable pumpout type facilities will be required on the project site.

BB. BENEFITS

96. GENERAL. - The lower Charles River Basin is located in the heart of the Boston Standard Metropolitan Statistical Area. Based on preliminary 1970 Census Data the SMSA is the eight largest in the country. It is the economic and cultural capital of the New England Region but its zone of influence extends far beyond the regional boundaries. A national leader in the fields of education, medicine, law and engineering it draws its clientele from all parts of the country and even from abroad.

The principal communities in the lower basin are the cities of Boston, Cambridge and Newton and the towns of Brookline and Watertown.

Boston, the State Capital, is the largest city in New England. Although it has a sizeable manufacturing industry employing over 70,000 people its primary economy is based on wholesale and retail trade, finance and insurance, Government (Federal, State and local) and services, particularly medical services. Higher education is also an important employer.

Cambridge is the site of Harvard University and Massachusetts Institute of Technology, each preeminent in their educational fields. Cambridge is also, considering its physical size, a manufacturing giant. Over 27,000 people are employed in manufacturing a broad range of products for both the regional and national market.

The three other communities in the lower basin are essentially bedroom suburbs of Boston and Cambridge.

97. FLOOD LOSSES. - Over 1,750 acres of valuable urban land lying along both banks of the Charles River in the lower basin are susceptible to flooding from high river stages due to flood runoff in the basin coincident with high tide in Boston Harbor. The flood of record in August 1955 caused losses estimated at $5.5 million with some of the principal losses being incurred by three large educational institutions, industrial properties in East Cambridge and commercial properties in Boston and Cambridge. The area's major traffic arteries, Soldiers' Field Road and Storrow Drive were inundated requiring the detouring of traffic with an A.D.T. of over 50,000 vehicles. Portions of Soldiers' Field Road were closed for a week.

A recurrence of the record flood levels of August 1955 would cause losses estimated at $17.9 million under 1971 conditions. By types the losses would be Urban (Commercial, residential, public) 31%, Industrial 26%, Institutional 33% and Transportation (highways) 10%.

98. TRENDS OF DEVELOPMENT. - As previously discussed the communities in the lower basin make up the governmental and financial center of the New England Region. They also loom large in the educational and medical fields. Current demands for land are high; urban renewal, public - under HUD - and private - under the auspices of major banks and insurance companies - is a continuing process in Boston. In Cambridge expansion of both educational institutions is also a continuing process. In addition research organizations and technical services, educationally oriented, are creating a demand for additional space. The result of all these forces for expansion is to put a premimum on all usable land and facilities to insure highest and best use. This will mean an increase in the loss potential in the basin over time.

99. ANNUAL LOSSES. - Recurring losses were converted to annual losses using standard damage frequency analysis. Based on current development and current (1971) price levels annual losses amount to $1,167,000. The dam is scheduled to be operational in 1976 so annual losses expected in that year are taken as the base for projecting future losses. The losses are expected to increase at 25% of the rate of increase from 1968 to 1971. Annual losses in 1976 are expected to be $1,225,000. Experience in southern New England has shown that flood loss potential increases with the passage of time especially urban flood losses. Part of the increase comes about from additions to existing facilities and some increase comes from new construction. A third factor is a continuing upgrading of plant and equipment in industrial and commercial facilities competing for advantage in the market place. These increases are directly related to the real wealth of a region. The best measure of this wealth is total personal income. For the Boston Region personal income has been projected in constant 1958 dollars through the year 2020. The Boston area is located in the North Atlantic Regional Study sub-region 0106 for which OBERS projects an increase in personal income of 6.5 times in the next 50 years.

The increase for intermediate bench mark years projected by OBERS are as follows:

1980 1.45 times 1970 base
2000 3.07 times 1970 base
2020 6.46 times 1970 base

Growth between bench mark years was assumed to be straight line.

The losses in the basin are projected to grow at a rate that is 30% of the growth in personal income through 2020 and then remain constant. Discounted to present worth with interest at 3 1/4% the average annual equivalent value of the growth is 0.768. Losses due to growth will amount to $941,000. Total average annual losses amount to $2,166,000.

100. TANGIBLE FLOOD CONTROL BENEFITS. - Tangible average annual flood control benefits were derived as the difference between annual losses expected in the Lower Charles River Basin over time with the existing dam but without the project and those that would remain after construction of a new dam with proposed new lock and pumping station to improve control of basin water levels. Benefits so derived amount to $1,600,000 on an average annual equivalent basis. Of the total benefits, $906,000 are to present development and $694,000 is the average annual equivalent value due to future growth.

101. HIGHER UTILIZATION. - In the course of the field survey of damages it was determined that over 800,000 square feet of basement space in commercial and industrial properties formerly used for storage or other operations is currently under-utilized because of the threat of flooding made evident by the 1955 flood. Holding the basin level to nondamaging levels will permit higher usage of this floor space. Current rental values for warehousing and storage space in Eastern Massachusetts run from $0.50 to $2.00 per square foot depending on utilities furnished and accessability for trucking. Considering all factors involved in the basement space in these plants it is reasonable to assign an annual value of $0.60 per square foot to increased utilization. The total benefit from higher utilization of space amounts to $480,000 annually.

102. ADVANCED REPLACEMENT BENEFIT. - The present dam acts as a barrier to prevent tidal flooding in the basin upstream of the dam and provides locking facilities for navigation. With high tidal stages in Boston Harbor a frequent occurrence, the benefits to the prevention of tidal flood damage in the area above the dam exceed $33 million annually. Assuming that the existing dam has a remaining life expectance of 38 years, to the year 2010, and that a new dam can be constructed at Warren Avenue, downstream of the present structure by 1976, this will extend the useful life of the present dam as a tidal barrier until 2076. The new dam can be credited with advance replacement benefits for the period 2010 to 2076. While in theory the present annual benefit for the prevention of tidal flooding is the measure of the benefit, the analysis was based only on the cost of the construction and

replacements necessary to make the present dam functionally operable in 2010, or $11.446 million. The computation of the benefit is set forth below.

a. Unneeded cost of replacement benefit:

(1) Annual cost, $11.446 million construction, 3-1/4% interest, 100 years = $387,200.

(2) Compound P.W. factor for 66 years @ 3-1/4% = 27.042117

(3) Single payment P.W. factor for 34 years @ 3-1/4% = 0.337084

(4) $387,300 x 27.042117 x 0.337084 x 0.033883 = 119,617 called $120,000.

b. Unneeeded operation and maintenance benefit:

(1) Annual cost = $160,300

(2) Compound P.W. factor for 34 years @ 3-1/4% = 20.397420

(3) $160,300 x 20.397420 x 0.033883 = $110,787, called $111,000.

c. Total annual advance replacement benefit = $120,000 + $111,000 = $231,000. Of this amount $155,000 has been allocated to flood control benefits and $76,000 has been allocated to navigation benefits.

103. AREA REDEVELOPMENT BENEFITS. - In areas which have been designated Redevelopment Areas by the Economic Development Administration, under P.L. 89-136, it is permissible to claim as a benefit to a project the wages paid to workers on the project who in its absence would be otherwise unemployed or underemployed. The basic requirement for designation as a Redevelopment Area is an unemployment rate substantially higher than the National average. While the Boston Labor Market Area as a whole has an unemployment rate just below the National average, both Boston and Cambridge have minority groups with unemployment rates several times the National average. The Roxbury-North Dorchester section of Boston is a sizeable community in its own right with over 90,000 residents. In a special study by the Bureau of Labor Statistics in 1966-1967 this area was found to have an unemployment rate of 7% compared with the Boston Labor Market rate of 3.3%. It was

further found that the slum area of this portion of the city had an unemployment rate of 24.2%. Independent communities much smaller than the study area have been designated Redevelopment Areas with such unemployment rates. As of 1971 these conditions still apply. In addition, the dam is within easy commuting distance of Lowell and Milford over a network of modern highways. Both of these communities have been designated Redevelopment Areas by the Economic Development Administration. The benefit of putting unemployed or underemployed construction personnel from these areas to work amounts to $136,000 on an annual basis. Derivation of the benefit is shown on Table 4.

104. SUMMARY OF FLOOD CONTROL BENEFITS. - Total tangible annual benefits other than navigation to construction of the dam are set forth below.

Flood Damages Prevented		$1,600,000
Higher Utilization		480,000
Advance Replacement		155,000
	Sub-Total	$2,235,000
Redevelopment		136,000
Total Annual Benefits		$2,371,000

105. NAVIGATION BENEFITS. -

a. General. - Charles River navigation occurs principally in the lower 8.6 miles of the river from the Watertown Dam downstream to the existing Charles River Dam. Navigation uses are both recreational and commercial in nature.

(1) Recreational Boat Usage - The need and justification for the new locks for recreational boating stems from benefits that would accrue to an estimated existing fleet of 800 basin-based boats, 100 equivalent transient trailer boats and 100 transferred boats, as a result of increased percent return; and to a prospective additional basin fleet of 1,200 boats and an equivalent future transient trailer fleet of 350 boats, as a result of improved operating conditions, added boating area, newly created mooring areas and new marinas in the basin. Some harbor of refuge benefits to craft navigating the exposed Boston Harbor area would also result. The prospective fleet was based upon the number of boats in the existing fleets and the number of boat passages through the existing lock. These estimates were based on data available through the end of 1967.

TABLE 4

REDEVELOPMENT BENEFITS

Work Years & Type of Labor	Average Hourly Rates	Man Hrs. Required	Wages	Present Worth Factor	Present Value	% Pd ARA	Wages
1st Year							
Skilled	8.70	153,000	$1,330,000	0.9685	$1,290,000	25	$ 320,000
Unskilled	6.35	125,000	800,000	.9685	770,000	75	580,000
2nd Year							
Skilled	8.70	201,000	1,750,000	.9380	1,640,000	25	410,000
Unskilled	6.35	165,000	1,050,000	.9380	980,000	75	735,000
3rd Year							
Skilled	8.70	201,000	1,750,000	.9085	1,590,000	25	400,000
Unskilled	6.35	165,000	1,050,000	.9085	950,000	75	710,000
4th Year							
Skilled	8.70	55,000	480,000	.8799	420,000	25	105,000
Unskilled	6.35	45,000	290,000	.8799	250,000	75	190,000
							$3,450,000

New Construction: 3,450,000 x 0.03388 (CRF 3-1/4% 100 yr life) = $117,000

O & M: Assume 6 men will be hired from unemployed or under employed force.
Assume hourly wage of $5.40. Total annual wages credited to redevelopment: 6 x 5.40 x 2,080 hrs. = $67,392.00. Assumed to be reduced from full value to 0 after 20 years.
Annual benefit due O & M: $67,392.00 divided by 20 times 168.02 (present value factor) times .03388.

$\frac{\$67,392.00}{20}$ x 168.02 x .03388 = $19,176.73 - Say $19,000

$117,000 plus $19,000 = $136,000

TOTAL REDEVELOPMENT BENEFITS $136,000

Based on Metropolitan District Commission records, the average annual number of boat passages through the existing lock for the period 1940 through the end of 1967, was 14,000. The number of boats involved in these passages was 900: 800 basin-based boats and 100 equivalent trailered boats. With no improvement to the existing lock system, the maximum number of boat passages via the existing lock was estimated in 1967 in Appendix E of the Interim Survey Report to increase to 20,000 per year over a period of 50 years (2017) after which it would remain constant. The review for this memorandum indicates this assumption is still valid. This represents an increase of 43% for 50 years, or 0.86% per year, based on a straight-line growth. The benefits were estimated to accrue to the 900-basin based and trailered boats, as well as 100 transferred boats.

The project is scheduled for completion in 1976 and will be operational shortly thereafter. At that time with the growth rate **projected above, the number of boat passages is estimated to** be 14,700. A check of the MDC records for 1968, 1969 and 1970, as shown in Table 5, reveals that the number of boat passages per year is already exceeding the average figures of 14,700. However, this is considered an atypical condition when considering a 50-year project life. Therefore, the rate of increase of 0.86% per year is expected to prevail over the long term.

TABLE 5

EXISTING LOCK
RECORDS OF LOCK USE AND BOATS

Year	Drawbridge Opening	Lock Openings	Commercial Vessels	Recreational Boats
1968	752	6117	451	15,575
1969	892	5882	710	14,935
1970	978	6405	785	16,225

SOURCE: MDC Records 1968-1970

By direct proportion, the number of boats that will be involved, in making the 14,700 passages by the end of 1975 will be $900/14,000 = x/14,700$ or $x = 945$. Based on the same ratio of basin-based boats to equivalent trailered boats as existed in 1967 (8 to 1), the number of basin-based at the end of 1975 will be about 840 and the number of trailer boats about 105. The annual benefits to these 945 boats, as well as to the 100 transferred boats (the number of which is not expected to change), if an improvement is made, are estimated to be $83,000 beginning in 1976. These benefits are derived in Table 6 and reflect 1971 depreciated boat values. They are immediate benefits as a result of the improvement.

TABLE 6

BENEFITS TO RECREATIONAL BOATING

Existing basin fleet (840 boats), equivalent transient trailer fleet (105 boats) and transferred fleet (100 boats)

TYPE OF CRAFT	LENGTH (feet)	No. of Boats	DEPRECIATED VALUE		PERCENT RETURN					ON CRUISE		
			AVERAGE $	TOTAL $	Ideal	% of Ideal Pres.	Ideal Fut.	Gain	VALUE	Avg. Days	% of Season	Value $
Outboards	15-20	470	1,800	846,000	14	85	100	2.1	17,800	--	--	--
Cruisers	15-30	315	6,000	1,890,000	9	85	100	1.4	26,500		10	2,700
	31-50	260	13,000	3,380,000	9	85	100	1.4	47,300		12	5,700
TOTALS		1,045		$6,116,000					$ 91,600			$ 8,300

$91,600-$8,300 = $83,300 SAY $83,000

Prospective additional basin fleet (1,170 boats) and equivalent transient trailer fleet (335 boats)

Outboards	15-20	780	1,800	1,404,000	14	0	100	14	196,600	--	--	--
Cruisers	15-30	410	6,000	2,460,000	9	0	100	9	231,400	--	10	23,100
	31-50	315	13,000	4,095,000	9	0	100	9	368,600	--	12	44,200
TOTALS		1,505		$7,959,000					$796,600			$67,300

$796,600 - $67,300 = $729,300

Average annual equivalent = $729,300 x 0.68[illegible] = $503,000

It was estimated in 1967 that the number of new boats that would be added to the existing fleets would be 1,200 basin-based boats and 350 equivalent trailered boats; the figures to be realized by the end of the year 2017. Thus, the total number of boats that would be using the new lock system by the end of the project life was estimated at 800 basin-based, 100 equivalent trailered boats, 100 transferred boats, 1,200 new basin-based boats, and 350 new equivalent trailered boats, or 2,550. This is considered about the maximum number that can be accommodated by the facilities expected. Since the existing fleet is expected to expand to 945 by the end of 1975 without improvement, the number of new boats that can be added to that fleet over the subsequent 50-year life (1976- 2026), would be 2,550 - 945 or 1,605. Of this number, 100 would be transferred boats. Therefore, the number of boats that would be added to the fleet from 1976 to 2026 would be 1,505. These boats would be added along an accelerated growth curve. The benefits are derived in Table 6 and discounted to provide an average annual equivalent benefit. These benefits also reflecting current depreciated boat values amount to $503,000.

In 1967 it was also estimated that the prospective fleet would make an average of 40,000 boat passages through the new locks each year by the year 2017. For benefit-cost analysis purposes, this was considered a maximum. This level of 40,000 passages is considered a reasonable projection and is retained. For purposes of this updating, the 40,000 will be assumed a maximum. Therefore, the increase in boat passages from 1,976 to 2026 is now (40,000-14,700)/14,700, or 172%. In 1967 the increase was 186% based on (40,000-14,000)/14,000 for 1967 to 2017. Without improvement, the number of boat passages through the existing lock was estimated to increase by 43% - (20,000-14,000)/14,000 for 1967 to 2017. For the period 1976 to 2026 the non-improvement increase would be (20,000-14,700)/14,700 or 36%. This is 0.72% per year. By direct proportion, the benefits would be $503,000 x 36/172 or $106,000. Thus, the net benefit from increased boating with improvements would be $503,000-$106,000, or $397,000 annually.

In addition, the harbor of refuge benefits would be $10,000. The summary of benefits follows:

Increased use of recreational boats (945 in 1975)	$83,000
New Recreational boating (1976 to 2026)	397,000
Harbor of Refuge	10,000
Total	$490,000

Spread over 100 years these benefits would be:

$490,000 x 24.55176 x .03388 = $407,589 Use:	$408,000
Advance Replacement	76,000
Total Annual Benefits	$484,000

(2) Commercial Vessel Usage -

(a) Commercial Use - The present and future use of waterway by commercial interests was re-investigated. Two firms, Cambridge Electric Company and Chevron Oil Company, are the only commercial interests using the lock. The Cambridge Electric Company on Broad Canal is the larger user and received 600,000 bbl. of No. 6 fuel oil during 1970-1971. This company is presently generating electricity and steam for commercial sale and direct heating. Fuel oil is used in the winter and off peak natural gas supplies used in the summer, i.e., 6 months oil and 6 months natural gas. This is dependent upon the amount of excess natural gas which is in turn dependent upon the seasonal weather changes.

The delivery rate averages 5 barges (6000 bbl) per week in the winter and 1 barge per week in the summer. There will be a small yearly growth, 1 1/2% of oil receipts keeping pace with population increases.

The rate of use of steam in the summer months has experienced a 400% increase in the last five years. This is due to the use of steam for air conditioning in large buildings by industry, government and educational institutions, and for heating domestic hot water.

The future use of natural gas is doubtful. Because of future shortages expected and the changing emphasis and economics of off peak natural gas usage, oil will be used increasingly and natural gas less. This means the total oil receipts would increase to 900,000 bbl per year with the deliveries all year round. This would nearly double the commercial traffic to Cambridge Electric Company within a relatively short time. Thus, the 1 1/2% per year average increase in oil receipts would be projected from

900,000 bbls per year rather than 600,000 bbls per year for the 50-year project life.

The only other commercial firm using the waterway is the Chevron Oil Company located on Lechmere Canal. In 1970, 214,000 barrels of No. 2 heating oil were received at this terminal. This past winter 1970-1971 had average deliveries of 2 barges per week. There is no sharp increase or decrease of commercial activity expected at this terminal.

(b) Other Uses - In addition to the possible continued use of the Charles River Basin and the navigation lock by the aforementioned companies, it is expected that other uses will also continue to be made of the lock and basin by work barges seeking access to the basin shorefronts for repairs, modifications and maintenance. Occasionally, heavy equipment is brought into industries along the basin by barge. The use of rail or trucks for such work is either impractical or uneconomical. Also, consideration is being given to dredging the basin to remove the extensive polluted materials from the bottom of the basin. All possible methods of disposal of these materials are being considered. At present, it appears that the only feasible method would be by barge to approved dumping areas at sea. The commercial lock will be needed for this method.

(c) Alternatives - A re-examination of the alternatives to providing a commercial lock in the basin, i.e., by pipeline or truck, shows that these are less attractive economically at this time, than they were at the time of preparation of the interim survey report. This is due primarily to the tremendous increase in labor and materials costs during the last three years. Also, the availability of land for rights-of-way are practically non-existent.

106. HIGHWAY TRANSPORTATION. - Provisions are included in the proposed project to design and construct the dam so that it will serve as a foundation to support a public highway bridge and to construct a highway viaduct across the dam. The benefits of this feature have been taken as the annual costs that would be incurred by a new elevated highway bridge at this location costing an estimated $2,000,000. On the basis of a 50-year bridge life, the annual costs amount to approximately $95,000. Converted to a 100-year series, the annual benefit becomes $80,000, equivalent to an alternative single purpose cost.

107. SUMMARY OF BENEFITS. - A summary of the total average annual benefits creditable to the project for flood control, navigation and highway transportation follows:

Benefit Category	Amount
Flood Control	$2,235,000
Navigation	484,000
Highway Transportation	80,000
Redevelopment Benefits	136,000
TOTAL AVERAGE ANNUAL BENEFITS	$2,935,000

CC. COST ALLOCATION

108. ALLOCATION OF COSTS. - Cost of the multiple-purpose Charles River Dam project allocated to flood control, navigation and highway transportation were made by the separable cost-remaining benefits method. A detailed breakdown of allocations among project purposes is shown in Appendix B.

109. APPORTIONMENT OF COSTS AMONG INTERESTS. - The apportionment of project first costs to Federal and Non-Federal interests is shown in Table 7. A detailed breakdown and a description of the basis for apportionment is included in Appendix B.

TABLE 7

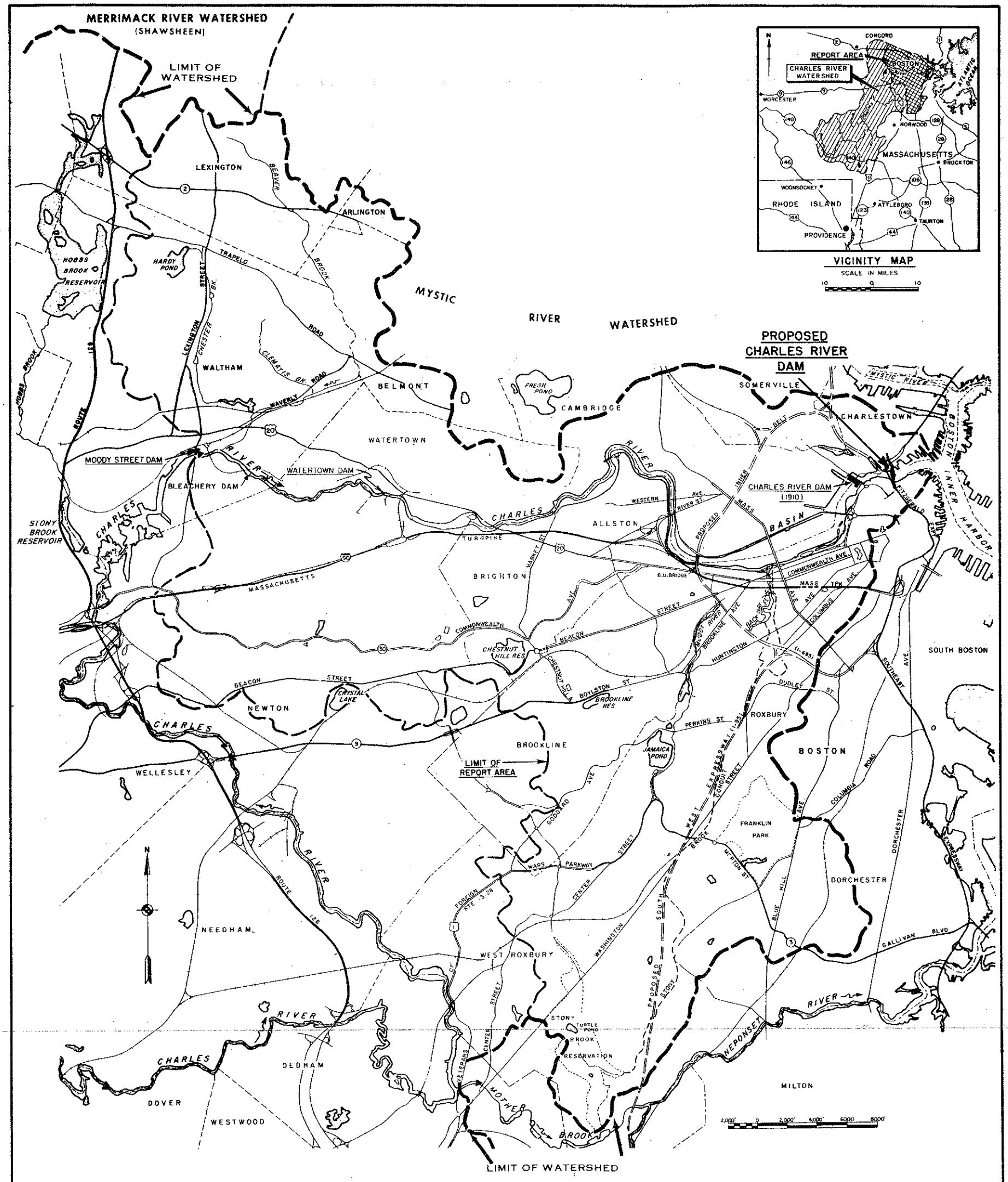
COST APPORTIONMENT

	Federal	Non-Federal	Total
Lands & Damages	$ 0	$ 400,000	$ 400,000
Relocations	0	7,100,000	7,100,000
Structures	24,755,000	5,545,000 1/	30,300,000
TOTAL	$24,755,000	$13,045,000	$37,800,000

1/ Based on non-Federal interests bearing 18.3 percent of the cost of the structural features of the project in accordance with the authorizing document (P.L. 90-483).

DD. RECOMMENDATION

110. RECOMMENDATION. - It is recommended that the project plan consisting of an earth dam, river pumping station, recreational and commercial boat locking facilities, a highway viaduct and appurtenant structures, submitted in this memorandum, be approved as the basis for completion of feature Design Memoranda and preparation of contract plans and specifications for the Charles River Dam Project. The project will be constructed at the mouth of the Charles River in Boston, Massachusetts, providing multiple-use for flood control, navigation and highway transportation. It is further recommended that the procurement of pumps and associated equipment by separate Government supply contract be approved.



WATER RESOURCES DEVELOPMENT PROJECT

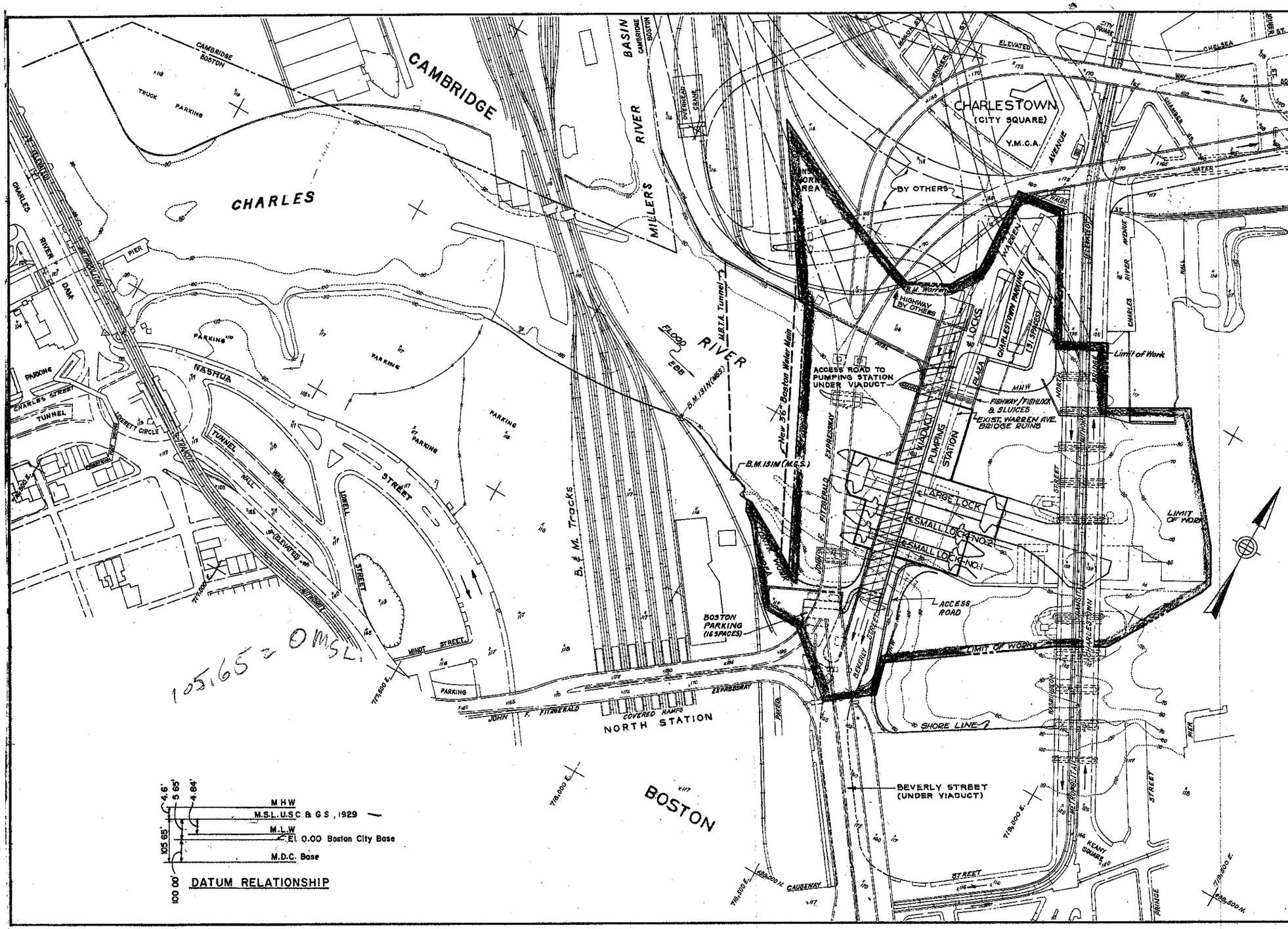
CHARLES RIVER LOCKS AND DAM

CHARLES RIVER BASIN — MASSACHUSETTS

LOWER CHARLES RIVER

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS — WALTHAM, MASS.

PLATE 2-1



REVISION	DATE	DESCRIPTION	BY

CHARLES A. MAGUIRE AND ASSOCIATES INC. BOSTON, MASSACHUSETTS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM MASSACHUSETTS

DES. BY | DR. BY | CK. BY

SUBMITTED:
ARCHITECT — ENGINEER
APPROVAL RECOMMENDED:
REVIEWED
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF PROJECT BRANCH

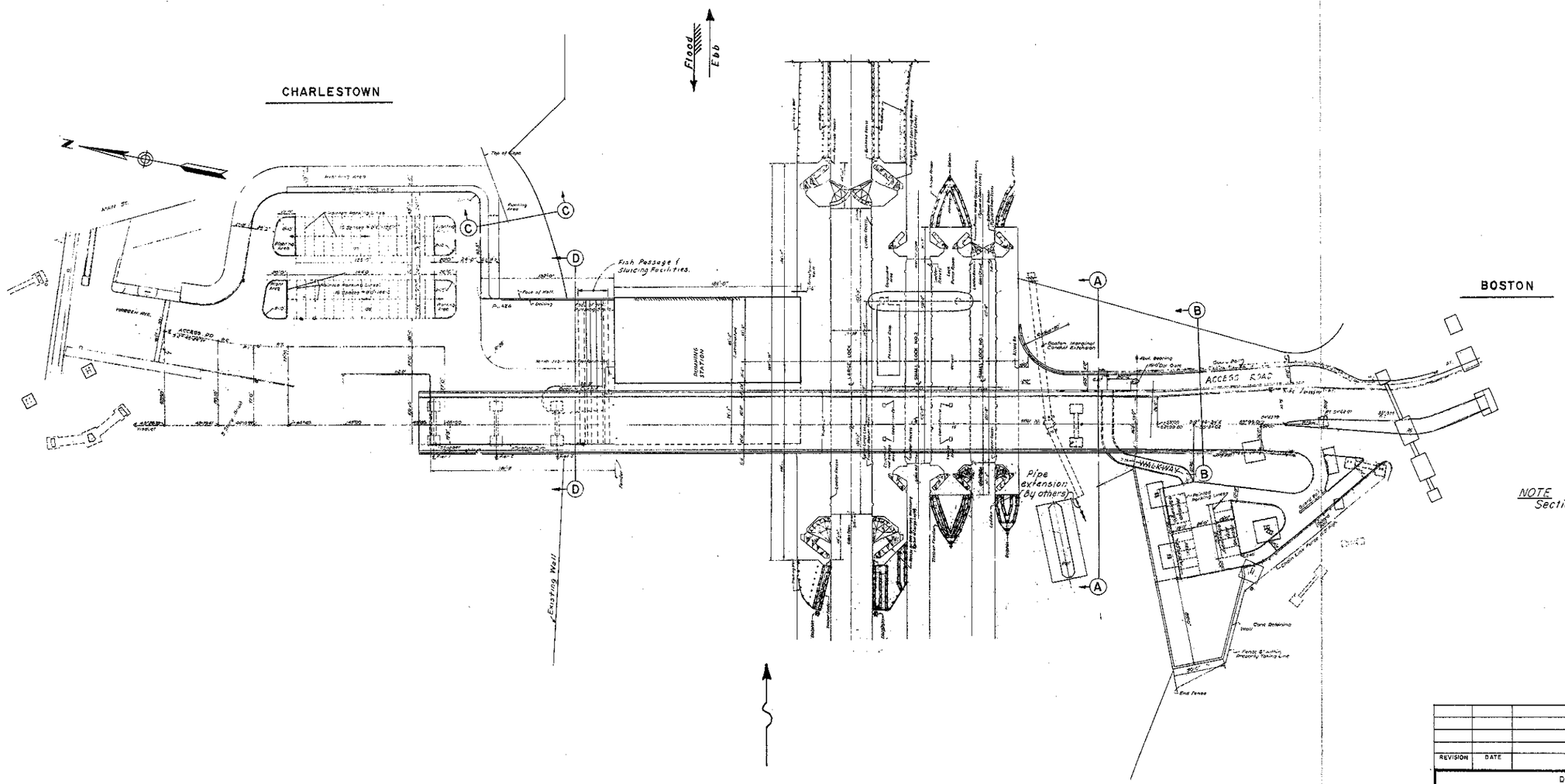
WATER RESOURCES DEVELOPMENT PROJECT
CHARLES RIVER LOCKS AND DAM
SITE PLAN
CHARLES RIVER BASIN MASSACHUSETTS

APPROVED DATE
CHIEF ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 2-2

BOSTON HARBOR



NOTE
Sections are shown on Plate 2-4

GRAPHIC SCALES
1"=50' 50' 0 50' 100'

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

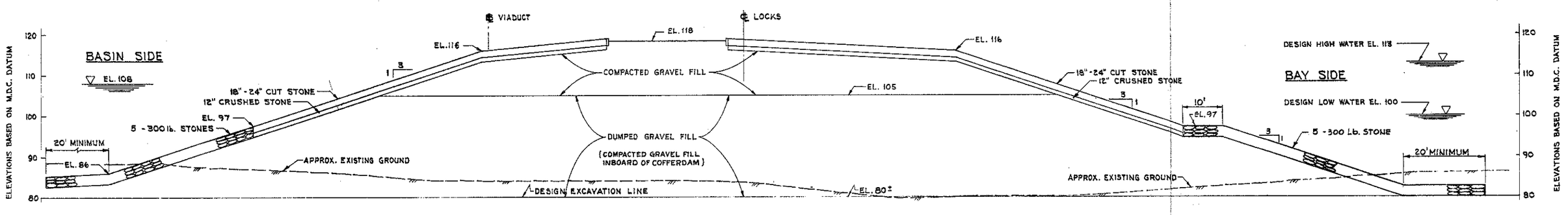
DES. BY	DR. BY	CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF, BRANCH

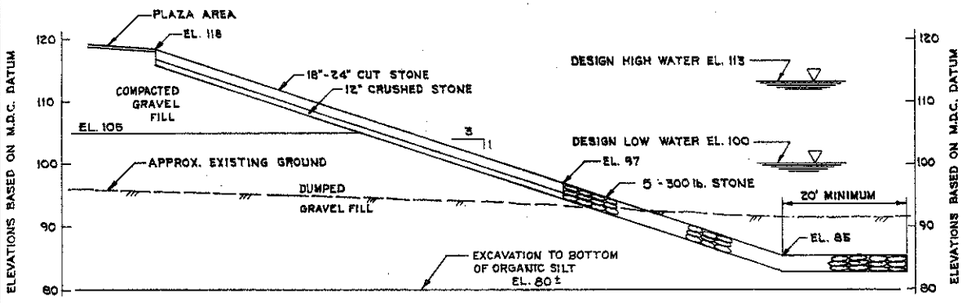
WATER RESOURCES DEVELOPMENT PROJECT
CHARLES RIVER LOCKS AND DAM
PROJECT PLAN
CHARLES RIVER BASIN MASSACHUSETTS
APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE: SPEC NO.
DRAWING NUMBER
SHEET

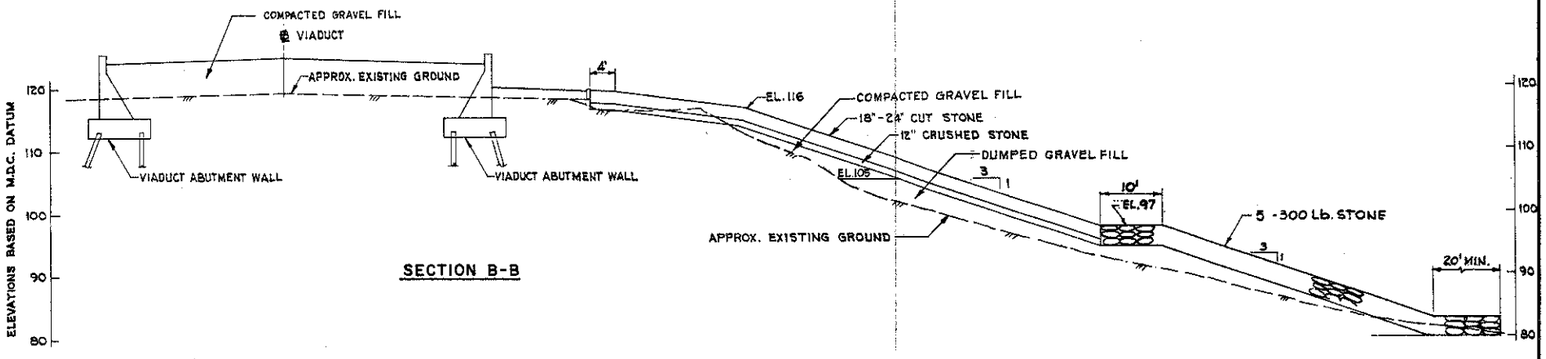
PLATE 2-3



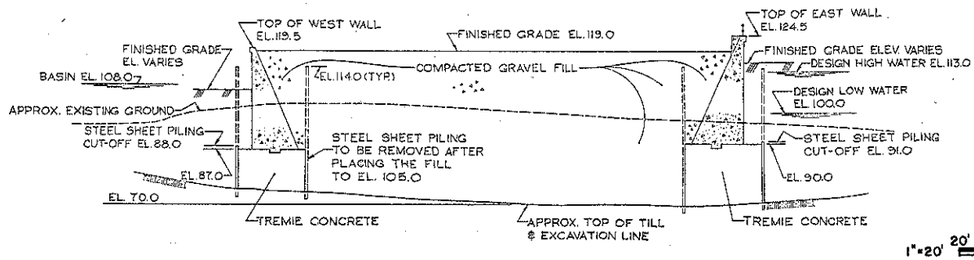
SECTION A-A



SECTION C-C



SECTION B-B



SECTION D-D

GRAPHIC SCALES

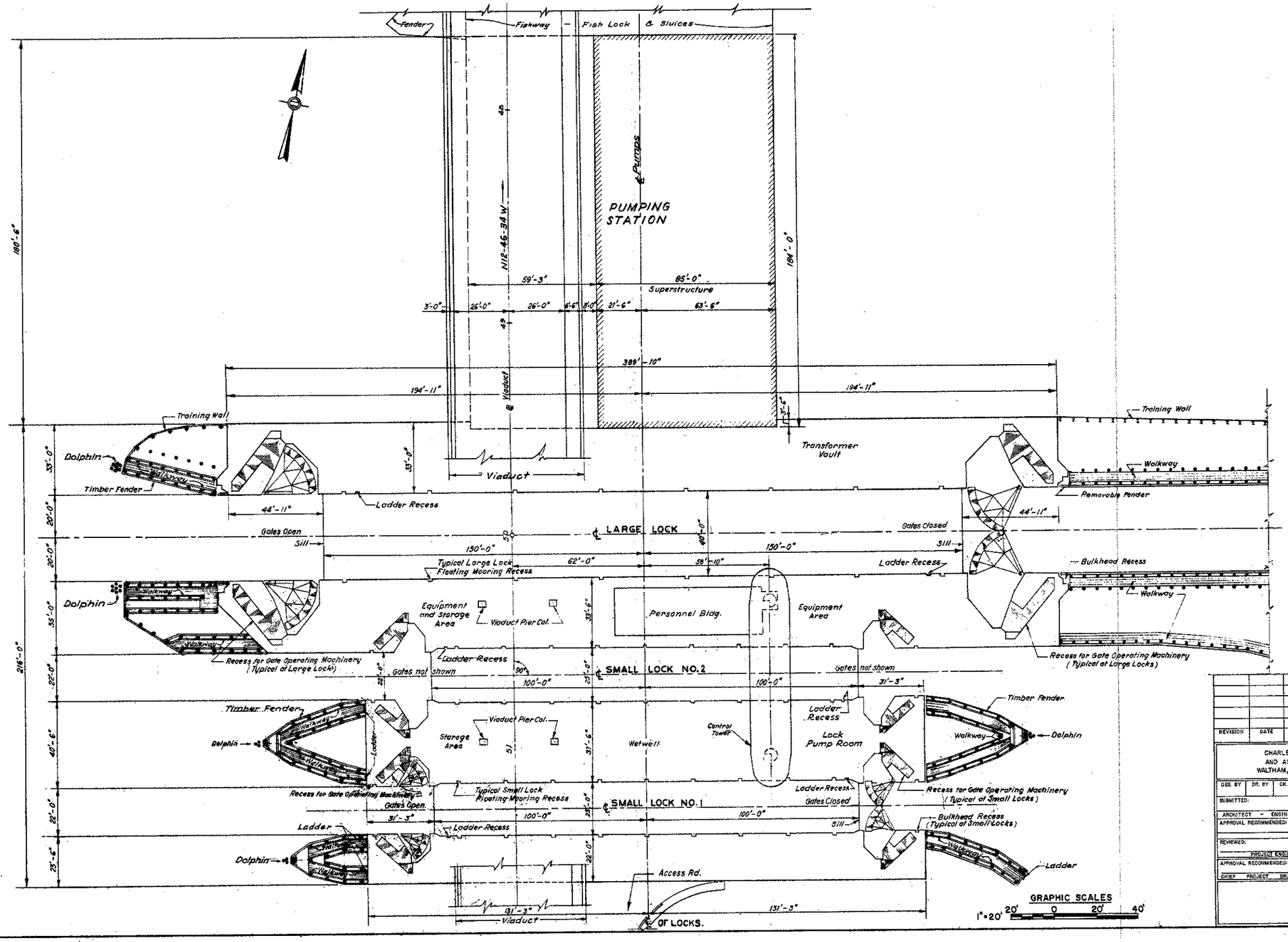
1"=20' 20' 0 20' 40'

WATER RESOURCES DEVELOPMENT PROJECT
CHARLES RIVER LOCKS AND DAM
CHARLES RIVER BASIN MASSACHUSETTS

EMBANKMENT
TYPICAL SECTIONS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS WALTHAM, MASS.

PLATE 2-4



REVISION	DATE	DESCRIPTION	BY

CHARLES A. MAGUIRE AND ASSOCIATES INC. WALTHAM, MASSACHUSETTS

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION, CORPS OF ENGINEERS WALTHAM MASSACHUSETTS

DES. BY	DR. BY	CK. BY

SUBMITTED:

ARCHITECT - ENGINEER

APPROVAL RECOMMENDED:

REVIEWED:

PROJECT ENGINEER

APPROVAL RECOMMENDED:

CHIEF PROJECT BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER LOCKS AND DAM

GENERAL STRUCTURE PLAN

CHARLES RIVER BASIN MASSACHUSETTS

APPROVED DATE

CHIEF ENGINEERING DIVISION

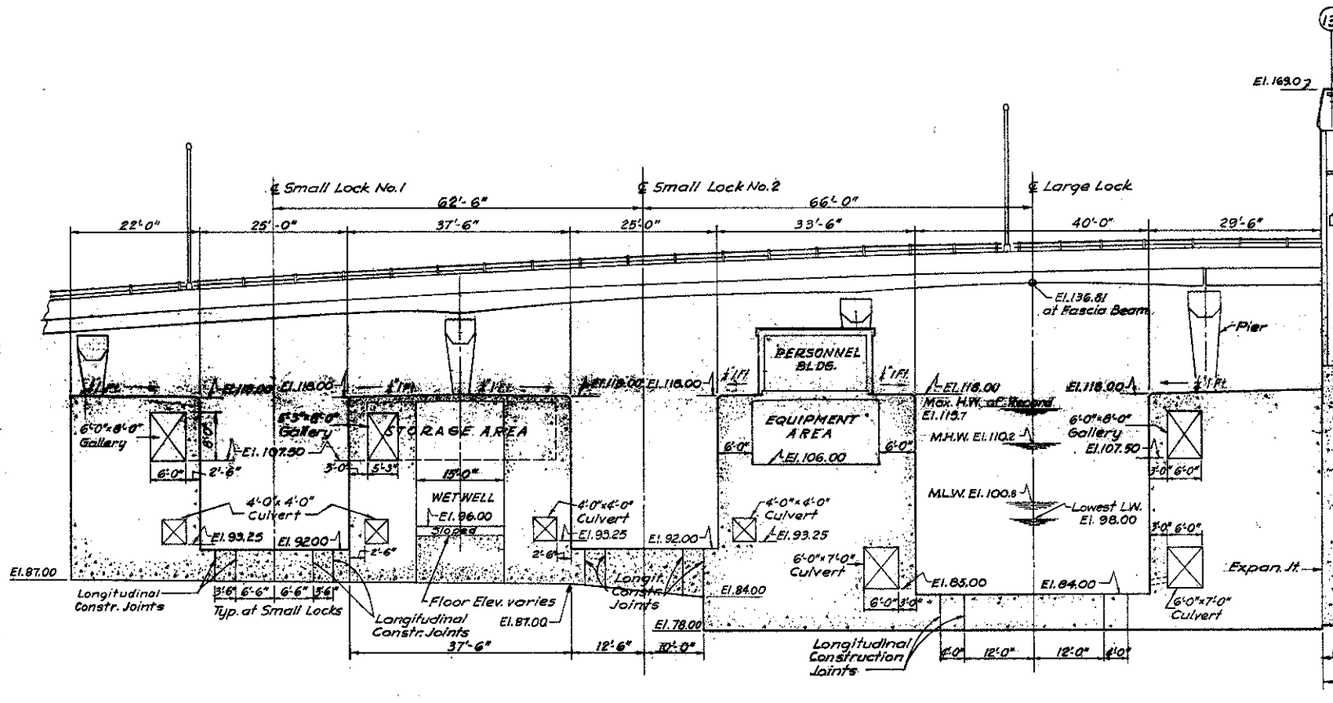
SCALE

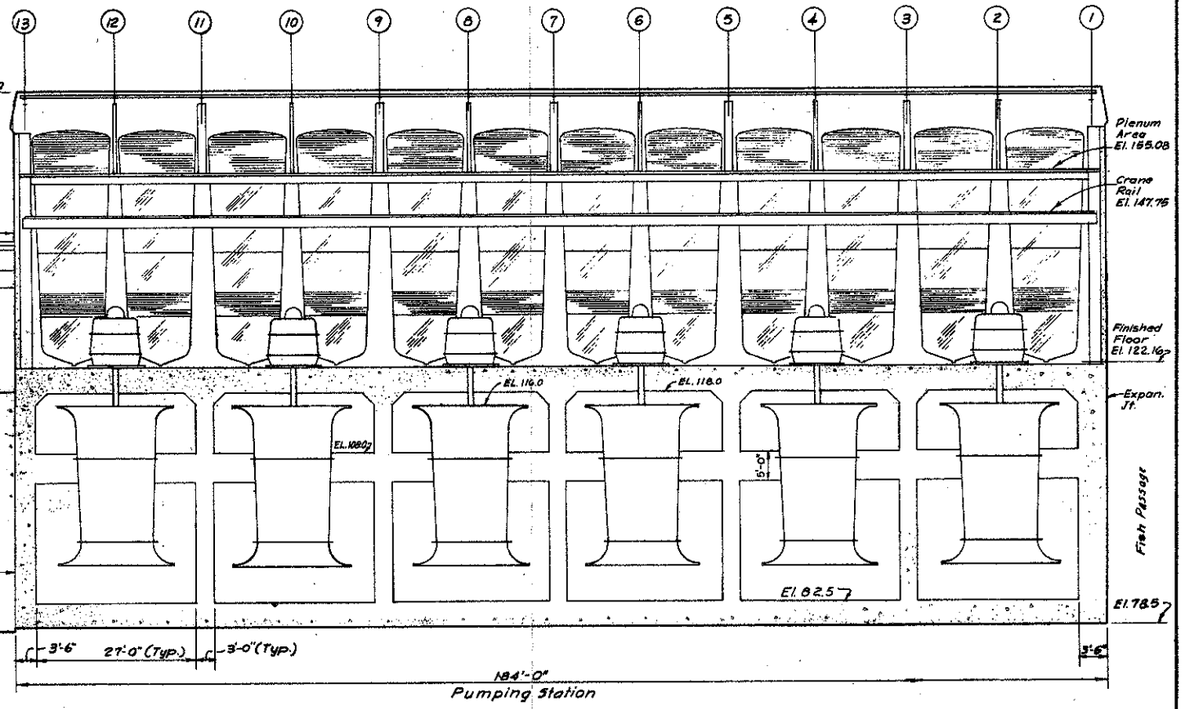
SPEC. NO.

DRAWING NUMBER

SHEET

PLATE 2-5





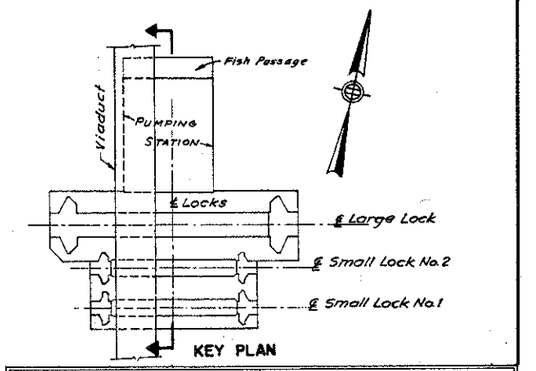
GENERAL STRUCTURAL NOTES

CONCRETE NOTES:

1. Concrete design is based on A.C.I. Code allowable unit stresses
2. Concrete shall develop the following minimum strength at 28 days:
   Fill Concrete _____ 2000 psi.
   All Other Concrete _____ 3000 psi.
3. Reinforcement steel shall conform to the requirements of A.S.T.M. Specifcation A 615 (Billet Steel) Grade 40, with allowable unit stresses of 20,000 psi in tension.
4. Cover over reinforcing bars shall be as follows unless otherwise indicated:
   Unformed surfaces in contact with foundation 6"
   Walls exposed to water _____ 4"
   Exposed top of locks _____ 3"
   Slabs _____ 1"
   Beams _____ 1½"
5. All exposed concrete corners shall be chamfered at least one inch unless otherwise indicated.
6. Keys at construction joints may be turned up or down at the Contractor's option
7. Reinforcing bars shall be lapped 30 diameters at all splices unless otherwise indicated.
8. Minimum embedment of dowels shall be 30 diameters
9. Unless otherwise indicated all exposed concrete surfaces, including recesses, shall be reinforced with #6 @ 12" each way, except that walls less than 18" thick shall be reinforced with #5 @ 12" each way, each face.
10. Horizontal corner reinforcing bars of the same size and spacing as the wall reinforcing shall be provided at the intersection of all walls.

STRUCTURAL STEEL NOTES:

1. Structural steel for Control Tower girders shall conform to A.S.T.M. Specification A 242 or A 441. All other Structural steel shall conform to A.S.T.M. Specification A 36 unless otherwise noted.
2. Details, fabrication and erection shall conform to the Standard Specifications of the American Institute of Steel Construction.
3. All welding shall conform to the requirements and standards of the American Welding Society.



GRAPHIC SCALES
3/32"=1'-0" 8' 0 8' 16' 24'

REVISION	DATE	DESCRIPTION	BY

CHARLES A. MAGUIRE AND ASSOCIATES INC. WALTHAM, MASSACHUSETTS

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION, CORPS OF ENGINEERS WALTHAM MASSACHUSETTS

DES. BY | DR. BY | CK. BY

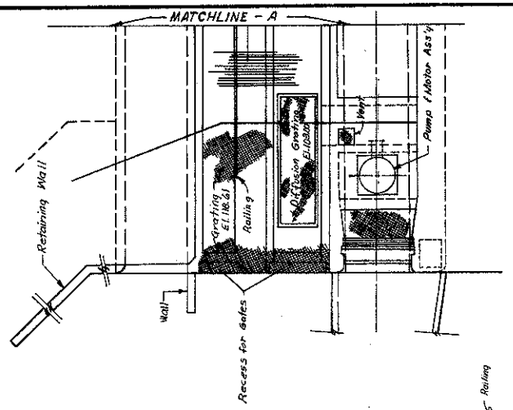
SUBMITTED:
ARCHITECT – ENGINEER
APPROVAL RECOMMENDED:
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF PROJECT BRANCH

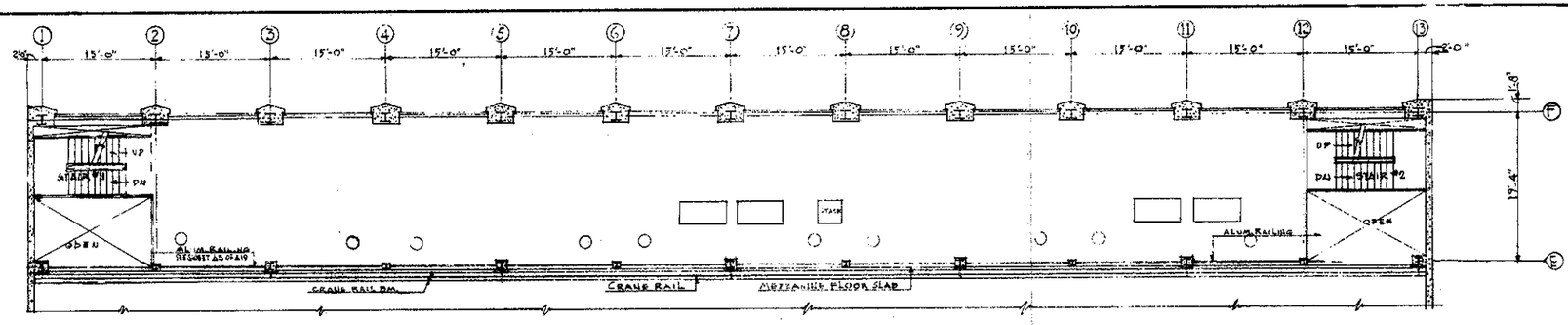
WATER RESOURCES DEVELOPMENT PROJECT
CHARLES RIVER LOCKS AND DAM
GENERAL SECTION THRU LOCKS
CHARLES RIVER BASIN MASSACHUSETTS

APPROVED DATE
CHIEF ENGINEERING DIVISION

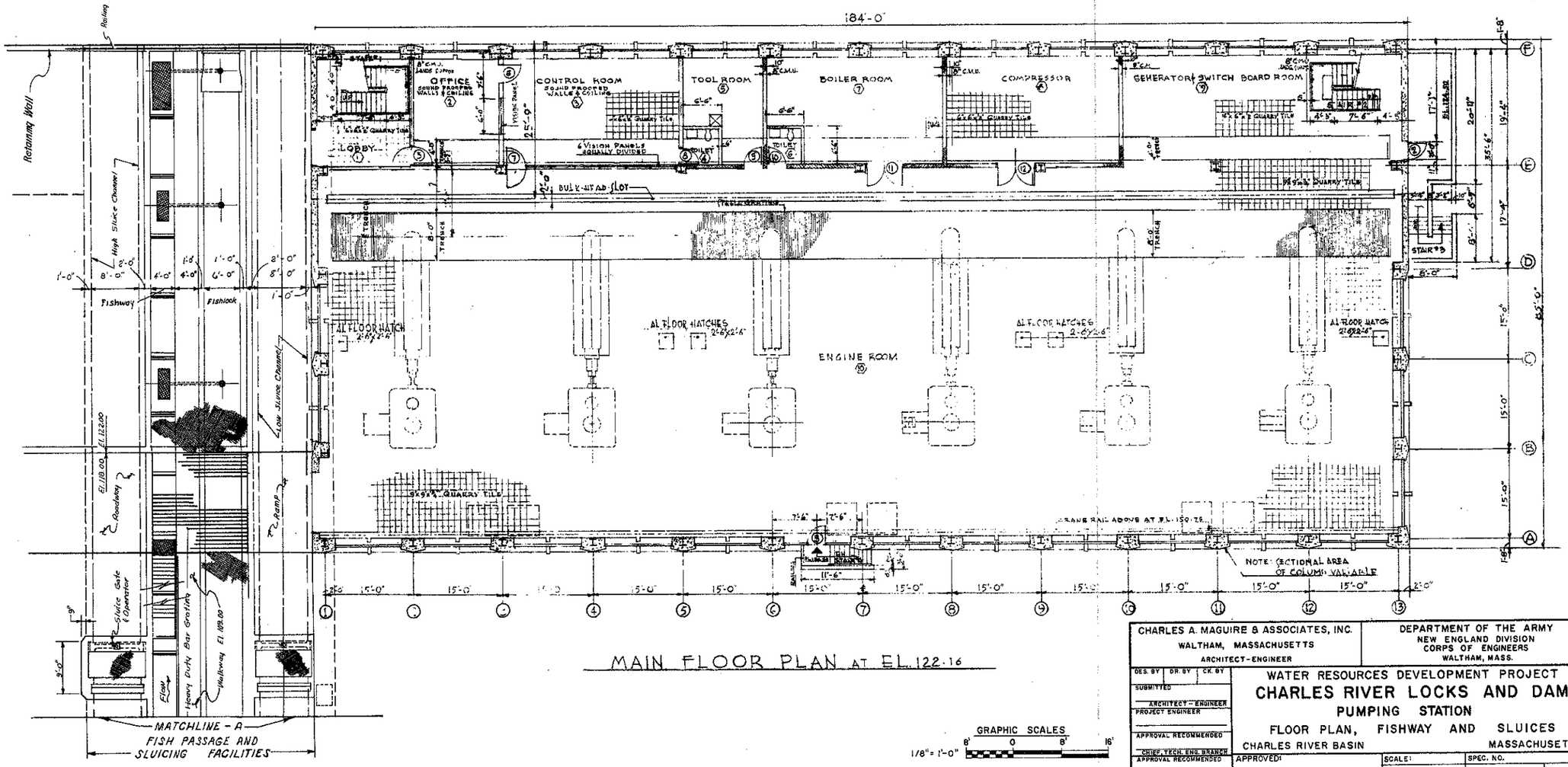
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

PLATE 2 - 6





MEZZANINE FLOOR PLAN AT EL. 140.50



MAIN FLOOR PLAN AT EL. 122.16

GRAPHIC SCALES
1/8" = 1'-0"
8' 0 8' 16'

CHARLES A. MAGUIRE & ASSOCIATES, INC. WALTHAM, MASSACHUSETTS ARCHITECT-ENGINEER	DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED
ARCHITECT - ENGINEER
PROJECT ENGINEER
APPROVAL RECOMMENDED
CHIEF, TECH. ENG. BRANCH
APPROVAL RECOMMENDED
CHIEF, PROJECT BRANCH
APPROVED:
CHIEF, ENGINEERING DIVISION

WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER LOCKS AND DAM

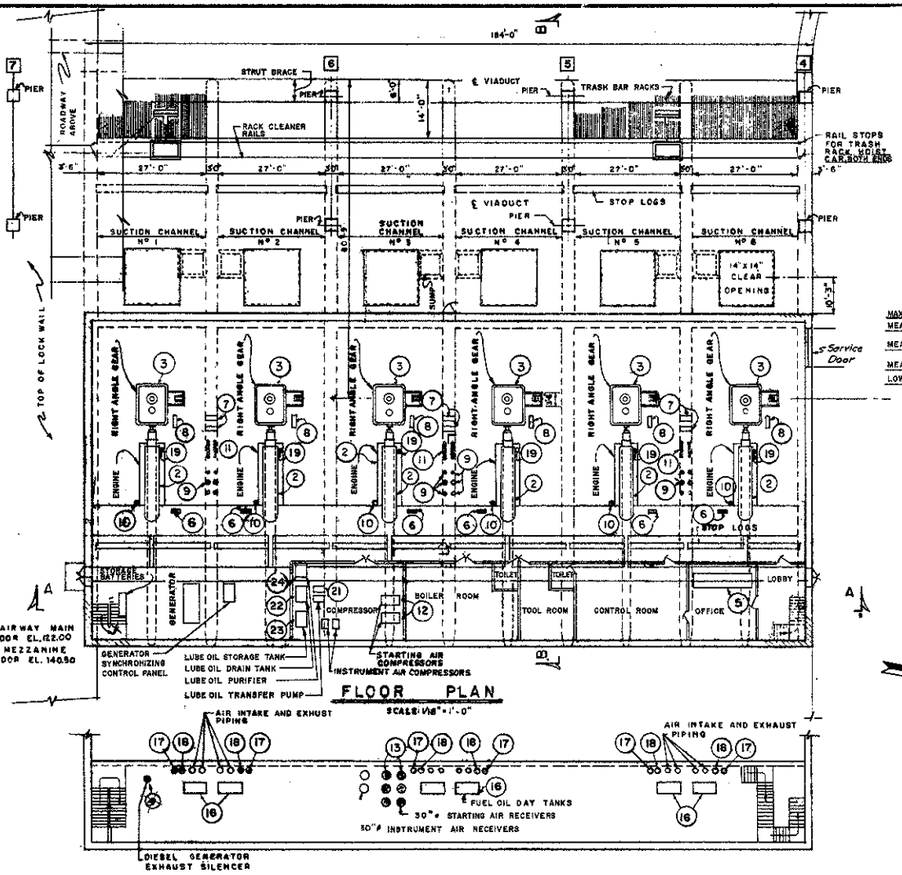
PUMPING STATION

FLOOR PLAN, FISHWAY AND SLUICES

CHARLES RIVER BASIN MASSACHUSETTS

SCALE: | SPEC. NO.
DATE: | DWG. NO. | SHEET

PLATE 2-7

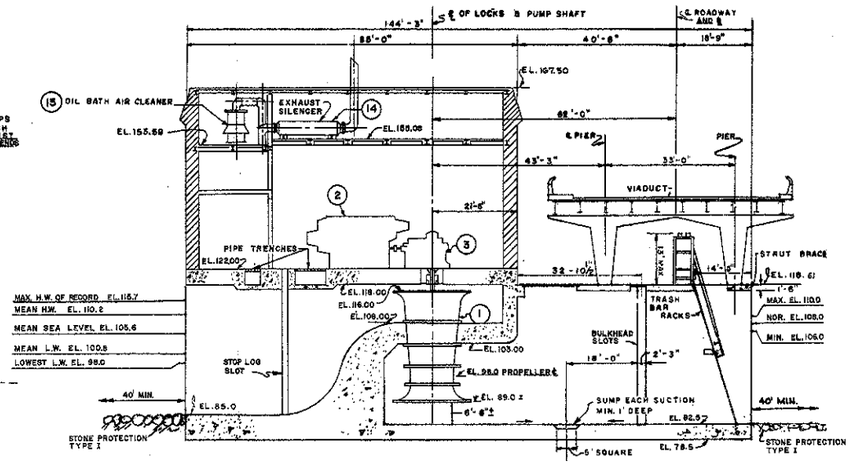


FLOOR PLAN

SCALE: 1/16" = 1'-0"

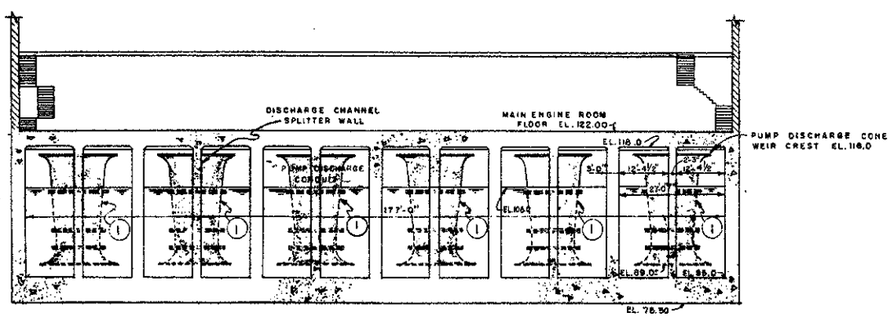
MEZZANINE FLOOR PLAN

SCALE 1/16" = 1'-0"



SECTION B-B

SCALE: 1/16" = 1'-0"



SECTION A-A

SCALE: 1/16" = 1'-0"

SCHEDULE OF PRINCIPAL FURNISHED EQUIPMENT
AUXILIARIES AND ACCESSORIES TO BE GOVERNMENT FURNISHED CONTRACTOR INSTALLED

KEY NO.	DESCRIPTION
1	FLOOD CONTROL PUMP
2	MAIN OIL DIESEL ENGINE
3	REDUCTION GEAR
4	OMIT
5	CENTRAL CONTROL CONSOLE
6	ENGINE CONTROL PANEL
7	ENGINE PRELUBE PUMP
8	GEAR LUBE PUMP
9	HEAT EXCHANGERS
10	LUBE OIL STRAINER
11	LUBE OIL FILTERS
12	STARTING AIR COMPRESSOR
13	STARTING AIR RECEIVERS
14	EXHAUST SILENCER
15	OIL BATH AIR CLEANER
16	FUEL OIL DAY TANK
17	JACKET WATER EXPANSION TANK
18	INTERCOOLER EXPANSION TANK
19	PUMP BEARING GREASE PUMP
20	OMIT
21	LUBE OIL TRANSFER PUMP
22	LUBE OIL DRAIN TANK
23	LUBE OIL STORAGE TANK
24	LUBE OIL PURIFIER

GRAPHIC SCALES

1/16" = 1'-0" 16' 0 16' 32'

REVISION	DATE	DESCRIPTION	BY

CHARLES A. MAGUIRE AND ASSOCIATES INC. BOSTON, MASSACHUSETTS

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION, CORPS OF ENGINEERS WALTHAM MASSACHUSETTS

DES. BY | DR. BY | CK. BY

SUBMITTED: ARCHITECT – ENGINEER

APPROVAL RECOMMENDED: REVIEWED: PROJECT ENGINEER

APPROVAL RECOMMENDED: CHIEF PROJECT BRANCH

APPROVED DATE CHIEF ENGINEERING DIVISION

WATER RESOURCES DEVELOPMENT PROJECT

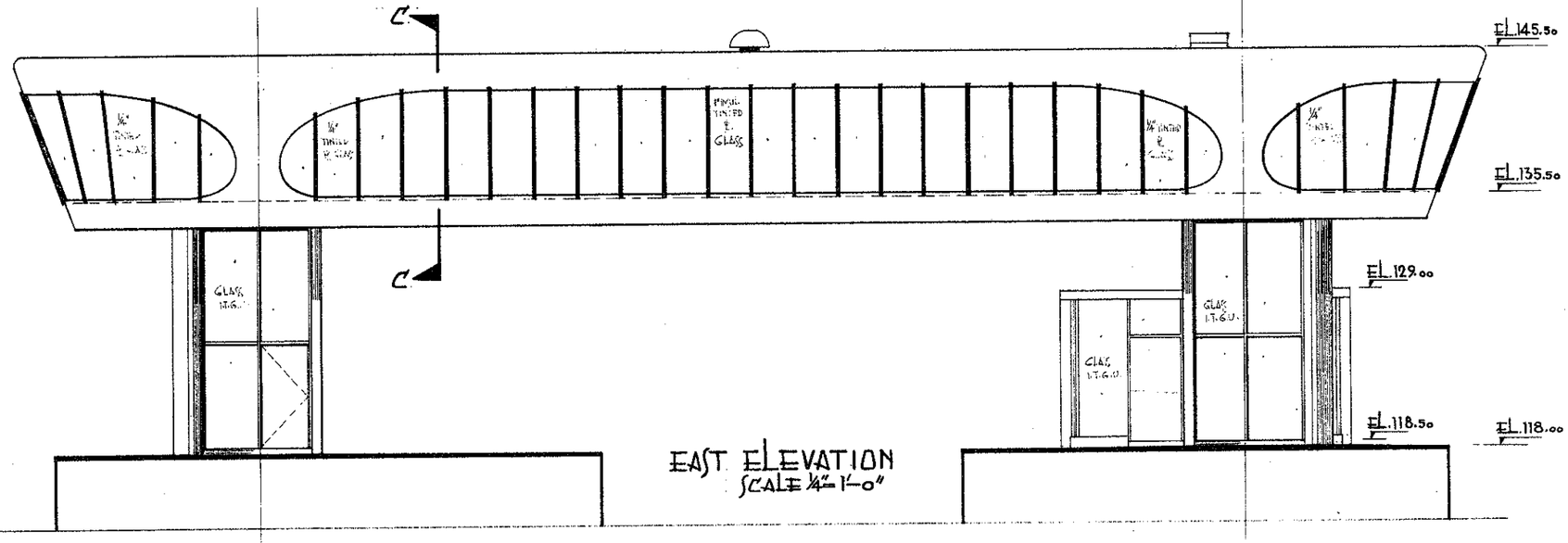
CHARLES RIVER LOCKS AND DAM

– EQUIPMENT LAYOUT – PLAN AND SECTIONS

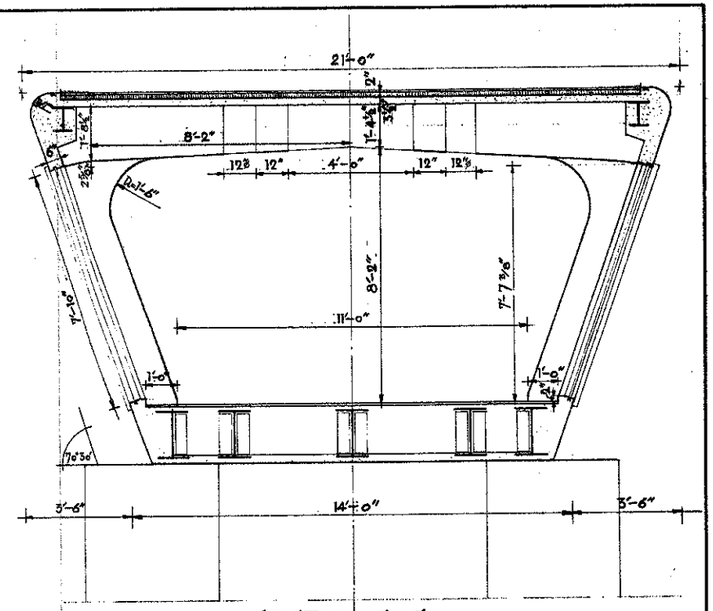
CHARLES RIVER BASIN MASSACHUSETTS

SCALE | SPEC. NO. | DRAWING NUMBER | SHEET

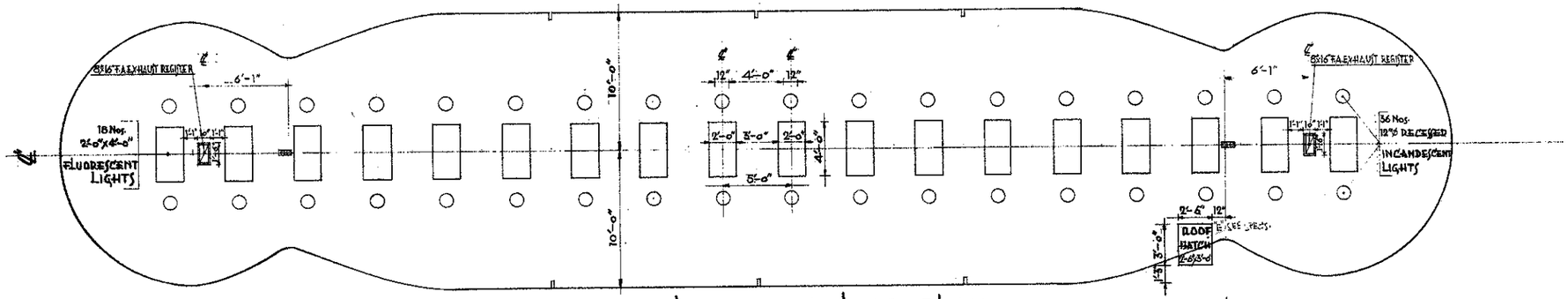
PLATE 2-8



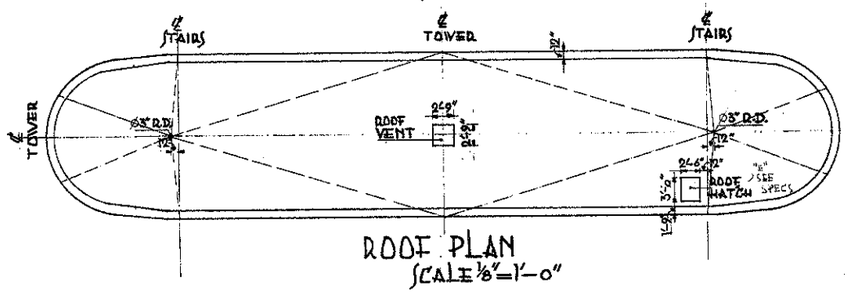
EAST ELEVATION
SCALE ¼"=1'-0"



SECTION C-C
SCALE ½"=1'-0"



REFLECTED CEILING PLAN
SCALE ¼"=1'-0"



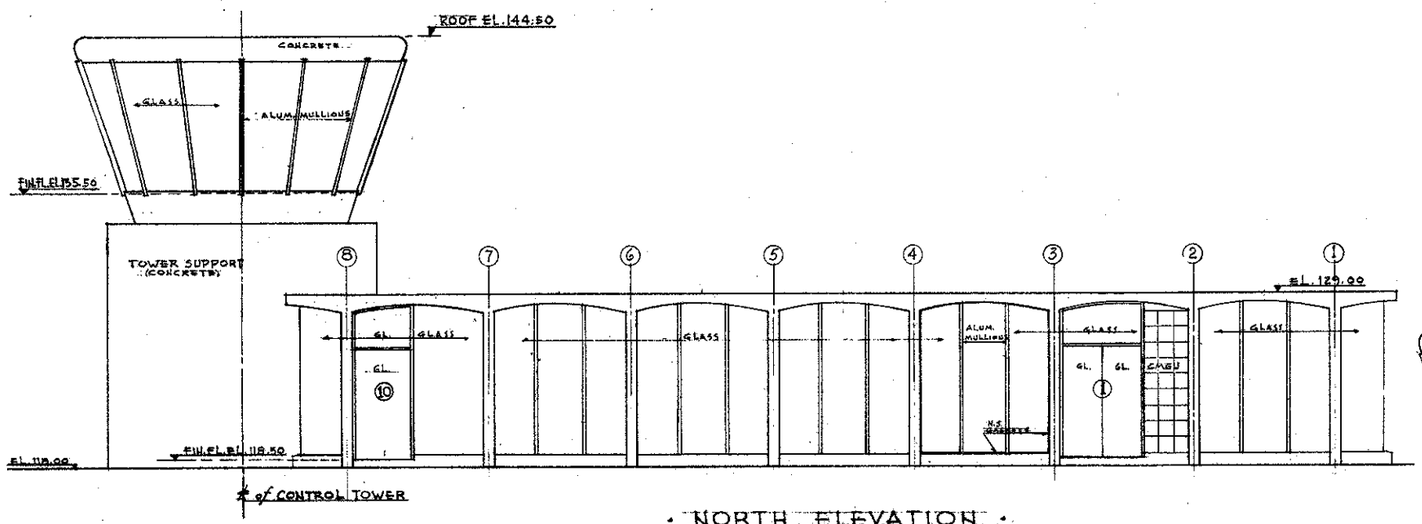
ROOF PLAN
SCALE ⅛"=1'-0"

GRAPHIC SCALES

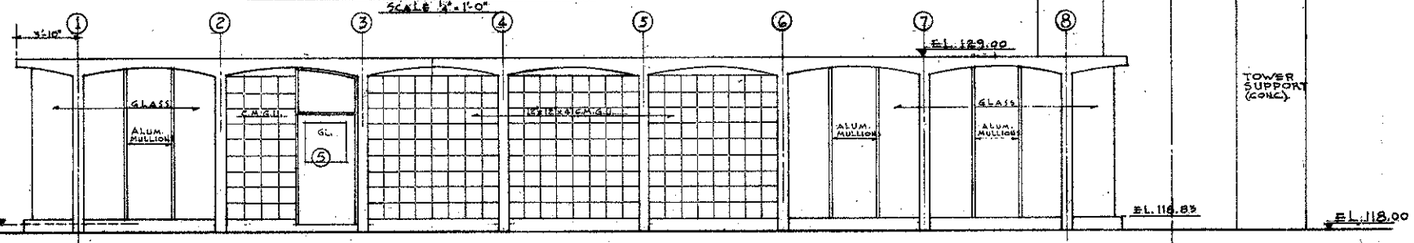
1/8" = 1'-0"
1/4" = 1'-0"
1/2" = 1'-0"

CHARLES A. MAGUIRE & ASSOCIATES, INC. WALTHAM, MASSACHUSETTS ARCHITECT-ENGINEER	DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS WALTHAM, MASS.
DES. BY / DR. BY / CK. BY; SUBMITTED; ARCHITECT-ENGINEER; PROJECT ENGINEER; APPROVAL RECOMMENDED; CHIEF, TECH. ENG. BRANCH; APPROVAL RECOMMENDED; CHIEF, PROJECT BRANCH	WATER RESOURCES DEVELOPMENT PROJECT CHARLES RIVER LOCKS AND DAM CONTROL TOWER PLANS, ELEVATION AND SECTIONS CHARLES RIVER BASIN MASSACHUSETTS
APPROVED: CHIEF, ENGINEERING DIVISION	SCALE: / DATE: / SPEC. NO. / DWG. NO. / SHEET

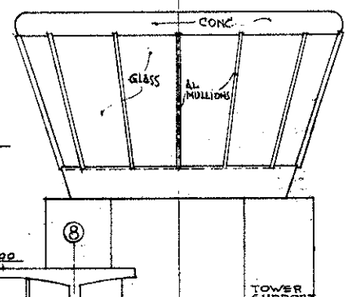
PLATE 2-9

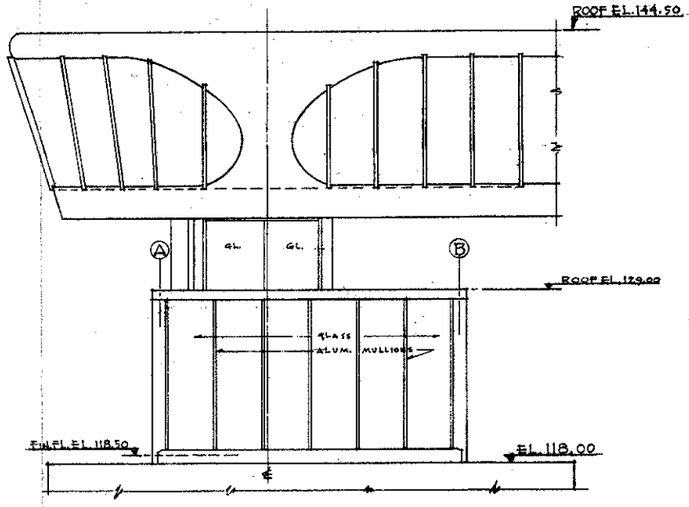


NORTH ELEVATION
SCALE 1/8" = 1'-0"

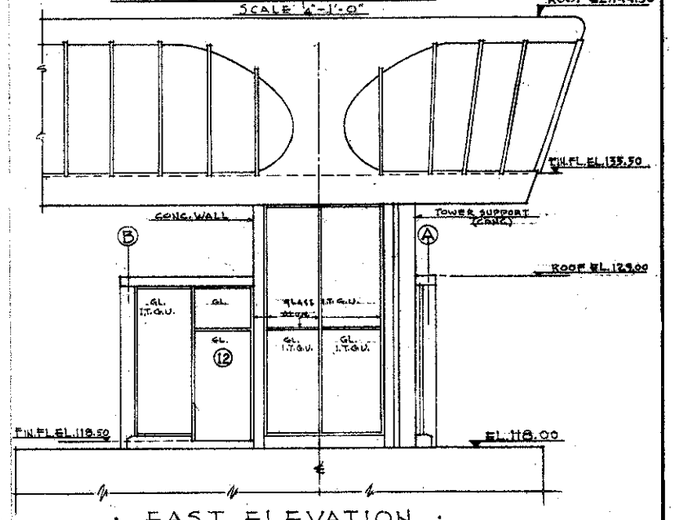


SOUTH ELEVATION
SCALE 1/8" = 1'-0"

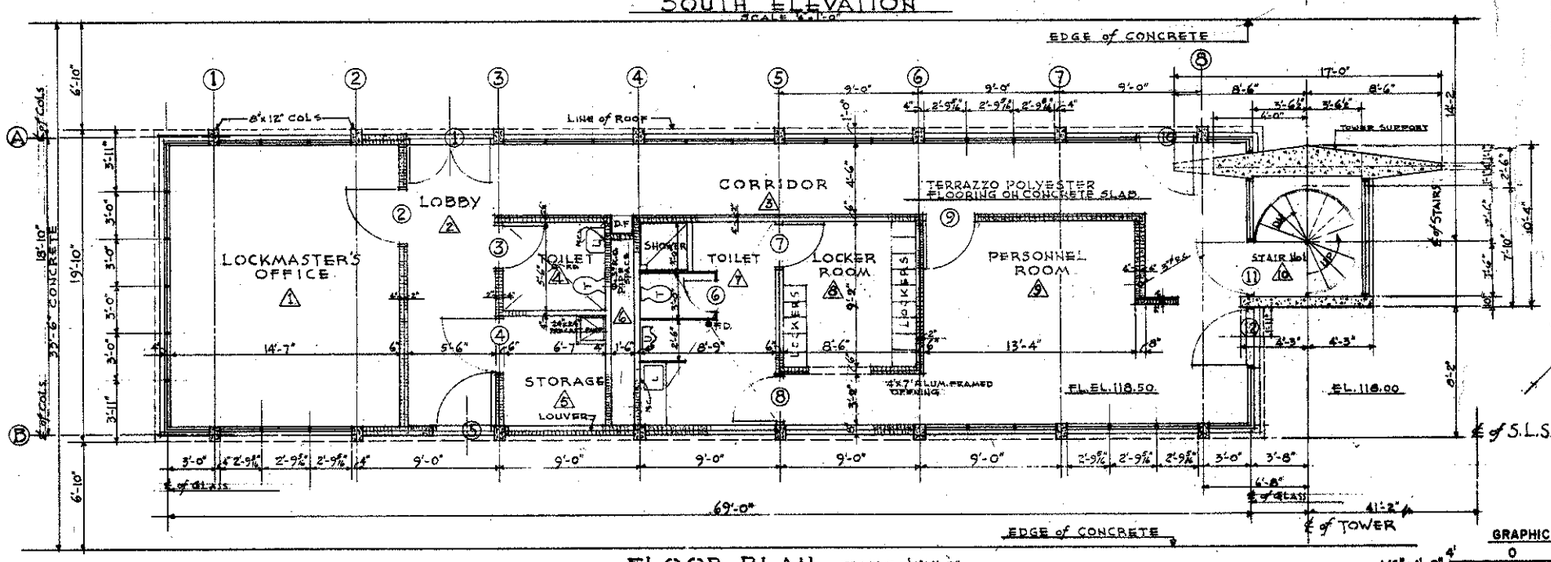




WEST ELEVATION
SCALE 1/8" = 1'-0"



EAST ELEVATION
SCALE 1/8" = 1'-0"

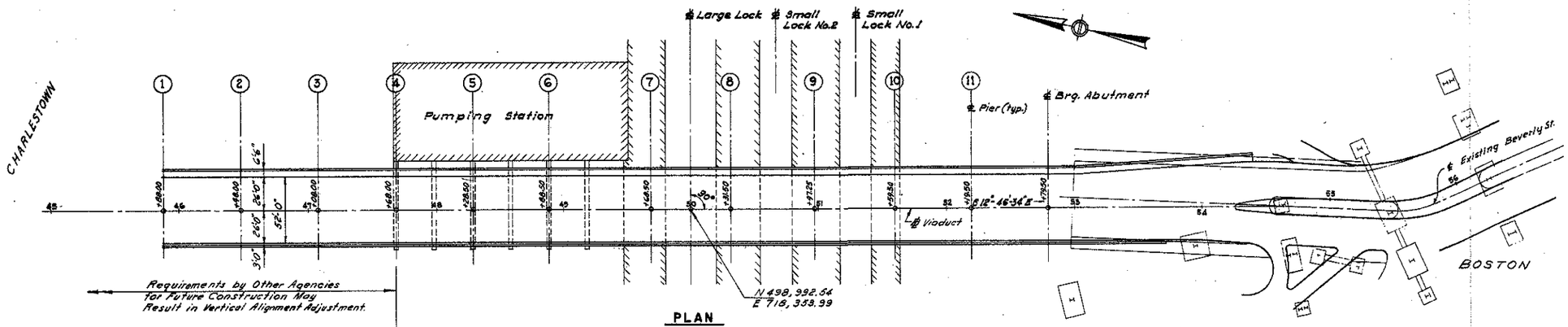


FLOOR PLAN SCALE 1/8" = 1'-0"

GRAPHIC SCALES
1/4" = 1'-0"
0 4' 8'

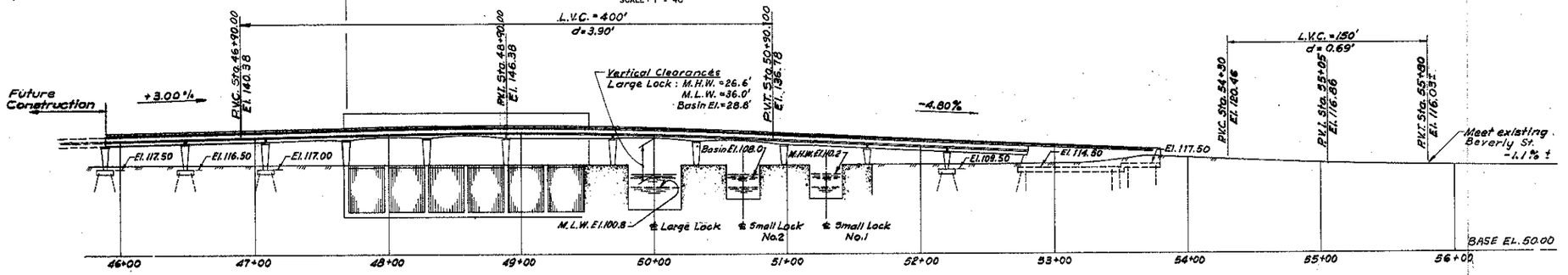
CHARLES A. MAGUIRE AND ASSOCIATES INC. WALTHAM, MASSACHUSETTS	DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION, CORPS OF ENGINEERS WALTHAM MASSACHUSETTS
DES. BY / DR. BY / CK. BY	WATER RESOURCES DEVELOPMENT PROJECT
SUBMITTED:	CHARLES RIVER LOCKS AND DAM
ARCHITECT - ENGINEER	PERSONNEL BUILDING
APPROVAL RECOMMENDED:	PLAN & ELEVATIONS
REVIEWED: PROJECT ENGINEER	CHARLES RIVER BASIN MASSACHUSETTS
APPROVAL RECOMMENDED: CHIEF PROJECT BRANCH	APPROVED DATE CHIEF ENGINEERING DIVISION
	SCALE / SPEC. NO. / DRAWING NUMBER / SHEET

PLATE 2-10



PLAN

SCALE: 1" = 40'



PROFILE

SCALE: 1" = 40'

GRAPHIC SCALES

1"=40' 40' 0 40' 80'

REVISION	DATE	DESCRIPTION	BY

CHARLES A. MAGUIRE AND ASSOCIATES INC. BOSTON, MASSACHUSETTS

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION, CORPS OF ENGINEERS WALTHAM MASSACHUSETTS

DES. BY | DR. BY | CK. BY

SUBMITTED:

ARCHITECT - ENGINEER

APPROVAL RECOMMENDED:

REVIEWED: PROJECT ENGINEER

APPROVAL RECOMMENDED: CHIEF PROJECT BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER LOCKS AND DAM

VIADUCT-GENERAL PLAN AND PROFILE

CHARLES RIVER BASIN MASSACHUSETTS

APPROVED DATE

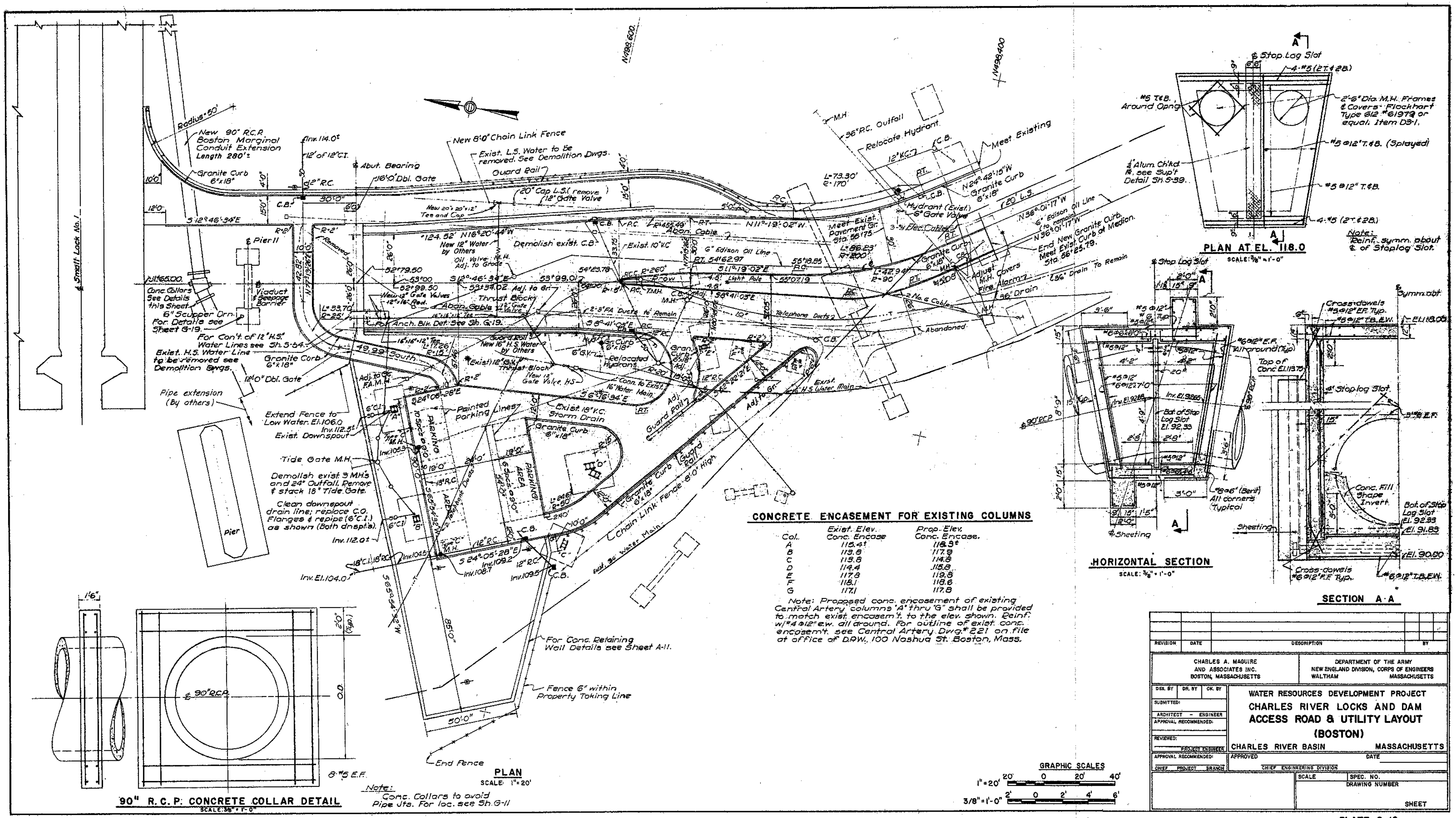
CHIEF ENGINEERING DIVISION

SCALE: AS NOTED | SPEC. NO.

DRAWING NUMBER

SHEET

PLATE 2-11



CONCRETE ENCASEMENT FOR EXISTING COLUMNS

Col.	Exist. Elev. Conc. Encase	Prop. Elev. Conc. Encase.
A	115.4±	118.3±
B	113.6	117.9
C	113.8	114.8
D	114.4	115.8
E	117.8	119.8
F	118.1	118.6
G	117.1	117.8

Note: Proposed conc. encasement of existing Central Artery columns "A" thru "G" shall be provided to match exist. encasem't. to the elev. shown. Reinf. w/#4 @12" e.w. all around. For outline of exist. conc. encasem't. see Central Artery Dwg. #221 on file at office of D.P.W., 100 Nashua St. Boston, Mass.

REVISION	DATE	DESCRIPTION	BY

CHARLES A. MAGUIRE AND ASSOCIATES INC. BOSTON, MASSACHUSETTS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM MASSACHUSETTS

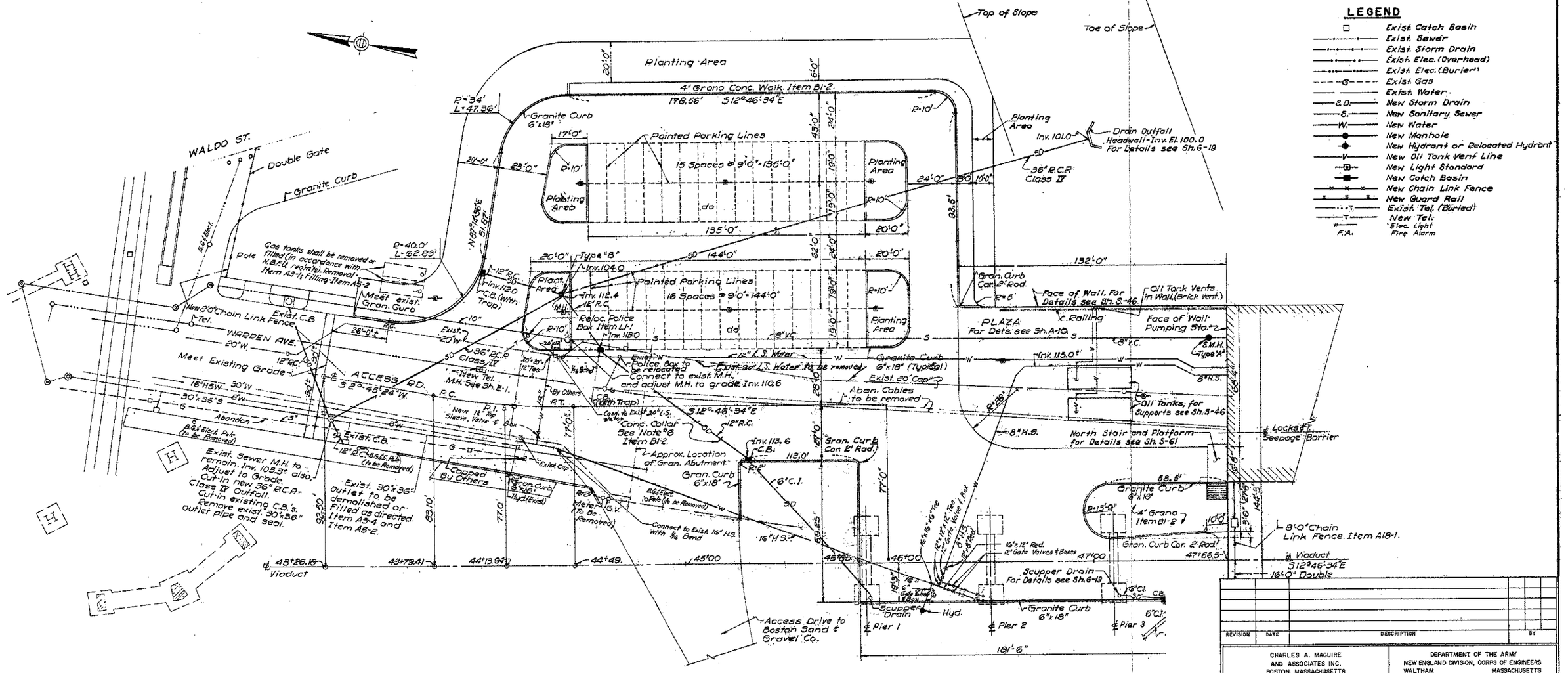
DES. BY | DR. BY | CK. BY

SUBMITTED: ARCHITECT - ENGINEER
APPROVAL RECOMMENDED:
REVIEWED: PROJECT ENGINEER
APPROVAL RECOMMENDED: CHIEF PROJECT BRANCH

WATER RESOURCES DEVELOPMENT PROJECT
CHARLES RIVER LOCKS AND DAM
ACCESS ROAD & UTILITY LAYOUT
(BOSTON)
CHARLES RIVER BASIN MASSACHUSETTS

APPROVED DATE
CHIEF ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET



LEGEND

- Exist. Catch Basin
- Exist. Sewer
- Exist. Storm Drain
- Exist. Elec. (Overhead)
- Exist. Elec. (Buried)
- Exist. Gas
- Exist. Water
- New Storm Drain
- New Sanitary Sewer
- New Water
- New Manhole
- New Hydrant or Relocated Hydrant
- New Oil Tank Vent Line
- New Light Standard
- New Catch Basin
- New Chain Link Fence
- New Guard Rail
- Exist. Tel. (Buried)
- New Tel.
- Elec. Light
- F.A. Fire Alarm

REVISION	DATE	DESCRIPTION	BY

CHARLES A. MAGUIRE AND ASSOCIATES INC. BOSTON, MASSACHUSETTS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM MASSACHUSETTS

DES. BY	DR. BY	CK. BY

SUBMITTED:

ARCHITECT – ENGINEER

APPROVAL RECOMMENDED:

REVIEWED:

PROJECT ENGINEER

APPROVAL RECOMMENDED:

CHIEF PROJECT BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER LOCKS AND DAM
ACCESS ROAD & UTILITY LAYOUT
(CHARLESTOWN)

CHARLES RIVER BASIN MASSACHUSETTS

APPROVED DATE

CHIEF ENGINEERING DIVISION

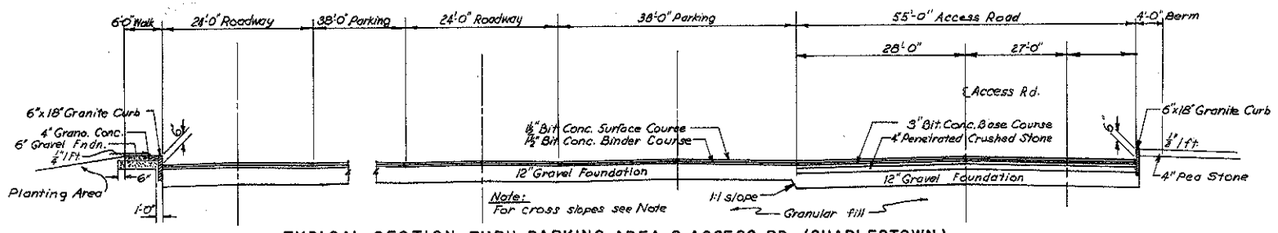
SCALE

SPEC. NO.

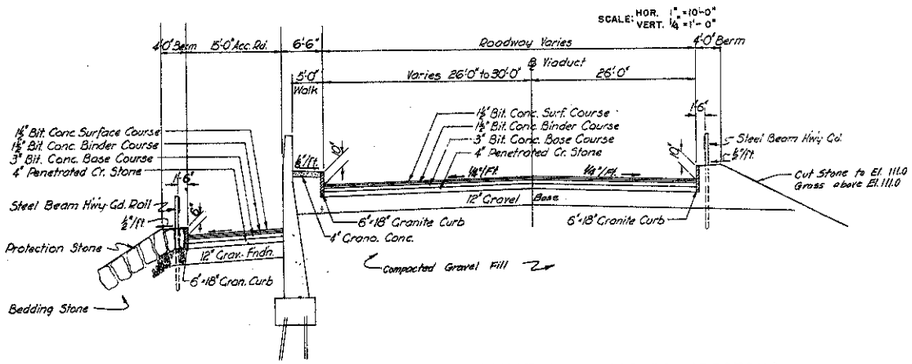
DRAWING NUMBER

SHEET

PLATE 2-13

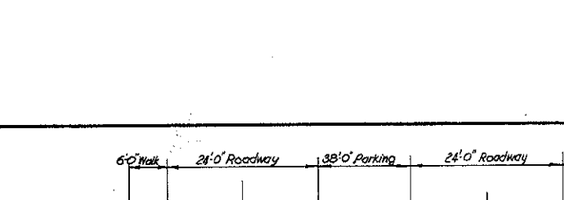


TYPICAL SECTION THRU PARKING AREA & ACCESS RD. (CHARLESTOWN)

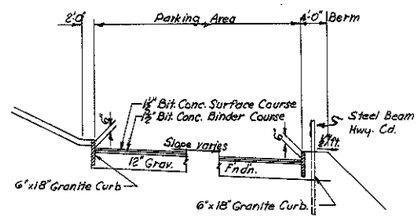


TYPICAL SECTION THRU VIADUCT & ACCESS RD. (BOSTON)

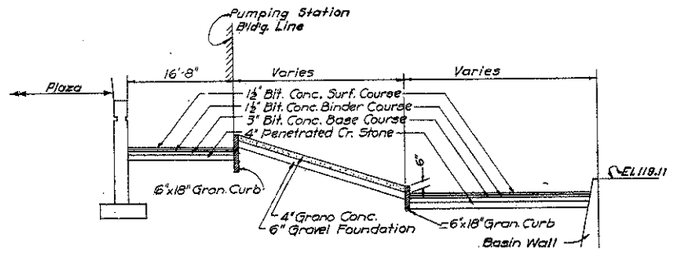
Not To Scale



SECTION THRU ACCESS RD.
(BOSTON)



TYPICAL SECTION THRU PARKING AREA (BOSTON)



SECTION THRU ACCESS RD. MEDIAN

(AT PUMPING STATION - CHARLESTOWN)

NOTE:

1. Roadway cross-slopes to be 4" per ft. unless otherwise indicated.

GRAPHIC SCALES

1/4" = 1'-0" 4' 0 4' 8'

1" = 10' 10' 0 10' 20'

REVISION	DATE	DESCRIPTION	BY

CHARLES A. MAGUIRE AND ASSOCIATES INC. BOSTON, MASSACHUSETTS

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION, CORPS OF ENGINEERS WALTHAM MASSACHUSETTS

DES. BY | DR. BY | CK. BY

SUBMITTED:

ARCHITECT – ENGINEER

APPROVAL RECOMMENDED:

REVIEWED:

PROJECT ENGINEER

APPROVAL RECOMMENDED:

CHIEF PROJECT BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER LOCKS AND DAM

TYPICAL ROADWAY SECTIONS & DETAILS

CHARLES RIVER BASIN MASSACHUSETTS

APPROVED DATE

CHIEF ENGINEERING DIVISION

SCALE | SPEC. NO.

DRAWING NUMBER

SHEET

PLATE 2-14

MATCH LINE

U.S. PIERHEAD & BULKHEAD LINE

Outer Face of Bridge Ovhd.

℄ Pier 9

℄ Pier 8

Approx. Cofferdam Limit during Stage I

Flood

Ebb

Viaduct

Locks

℄ Large Lock

N 499,000

E 718,400

S12° 46' 34" E

50100.00

N 498,992.54
E 718,353.99

Temporary by-pass navigation channel during STAGE I

Approx. Cofferdam Limit during Stage I

Excavate to El. 65

CANAL

Approx. top of Excavated Slope

℄ BEVERLY ST.

U.S. PIERHEAD & BULKHEAD LINE

℄ Pier 7

℄ Pier 6

Boston Gas Co. 42" Submarine Conduit, Inv. El. 57.6 to remain.

6" MBTA Sub. Cables (To be relocated by others)

Excavate to Elev. 75.

Draw Pier

Excavate to El. 75

Existing Timber Fenders to remain during Stage I at Pier 5 & Draw Pier, and at Gas Conduit at Piers 5 & 6 permanently.

℄ Pier 5

Charlestown Bridge

℄ Pier 4

Boston Edison Submarine Conduit (Abandoned)

Boston Fire Dept. Fire Alarm Division 2 Submarine cables

N.E.T. & T. Co. 18 Submarine Cables

℄ Pier 3

℄ Pier 2

E 718,800

N 498,500

SUBMARINE SIGNAL CO. Warehouse on Piles

℄ Pier 1

E 719,200

N 499,000

W. Level Tube

Old Street Car Barn

WARREN AVE

PARKING AREA

WASHINGTON ST. (NORTH)

Approx. Top of Excavated Slope

Exist. granite wall

Excav. to Elev. 95.

The Contractor shall provide Protective Steel Sheet Piling, as required, at this location. See Specs.

Granite Abutment

36" Steel Pipe to remain.

Granite Abut.

Existing Timber Wall

Excav. to Elev. 90.

E 719,460

℄ Pier 10

Approx Cofferdam Limit during Stage I.

Excav. to Elev. 85.

MATCH LINE

℄ Locks

Outer Face of Bridge Overhead

GRAPHIC SCALES

1"=40' 40' 0 40' 80'

REVISION	DATE	DESCRIPTION	BY

CHARLES A. MAGUIRE AND ASSOCIATES INC. BOSTON, MASSACHUSETTS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM MASSACHUSETTS

DES. BY | DR. BY | CK. BY

SUBMITTED:
ARCHITECT - ENGINEER

APPROVAL RECOMMENDED:

REVIEWED:
PROJECT ENGINEER

APPROVAL RECOMMENDED:
CHIEF PROJECT BRANCH

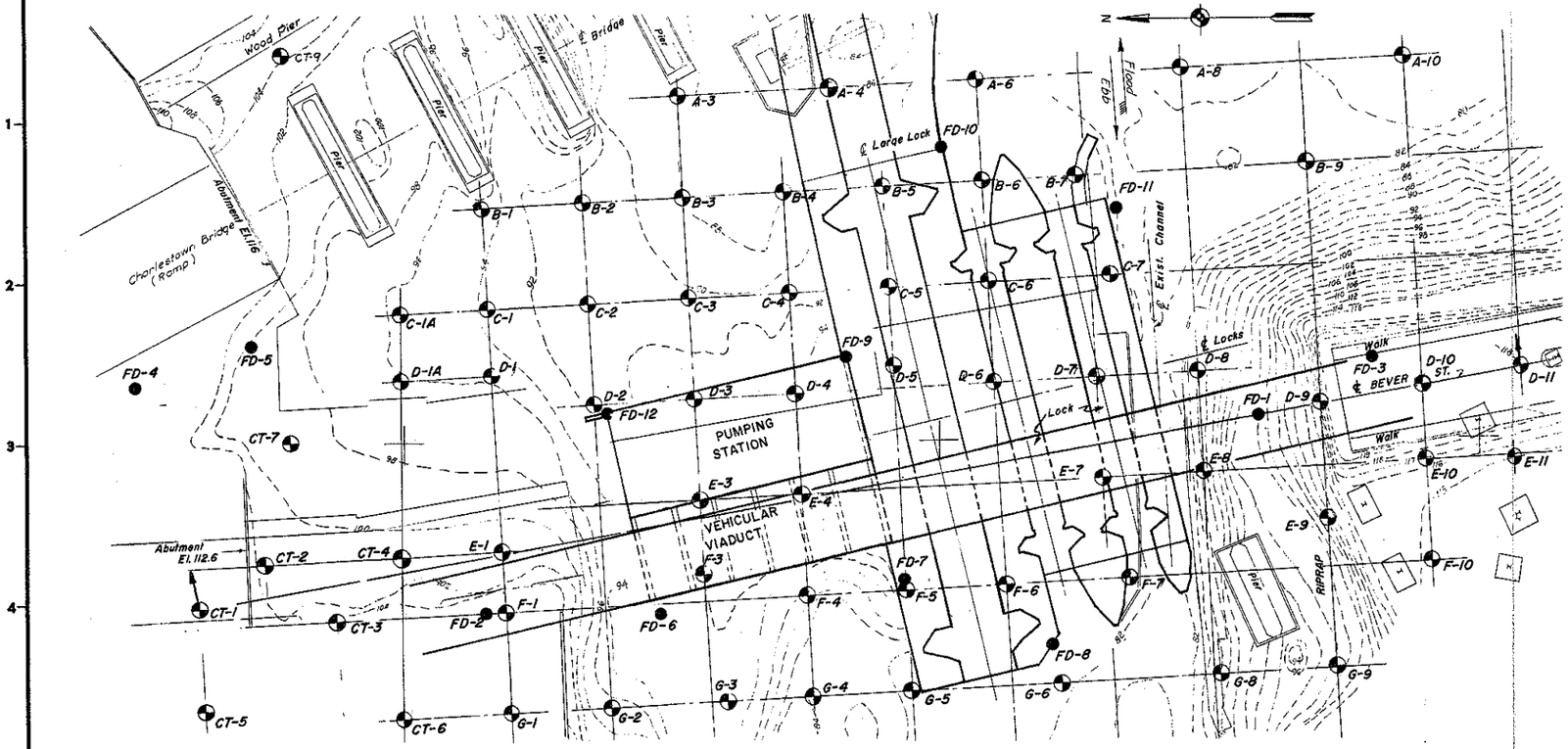
WATER RESOURCES DEVELOPMENT PROJECT
CHARLES RIVER LOCKS AND DAM
EXISTING CHARLESTOWN BRIDGE
PLAN
CHARLES RIVER BASIN MASSACHUSETTS

APPROVED DATE
CHIEF ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

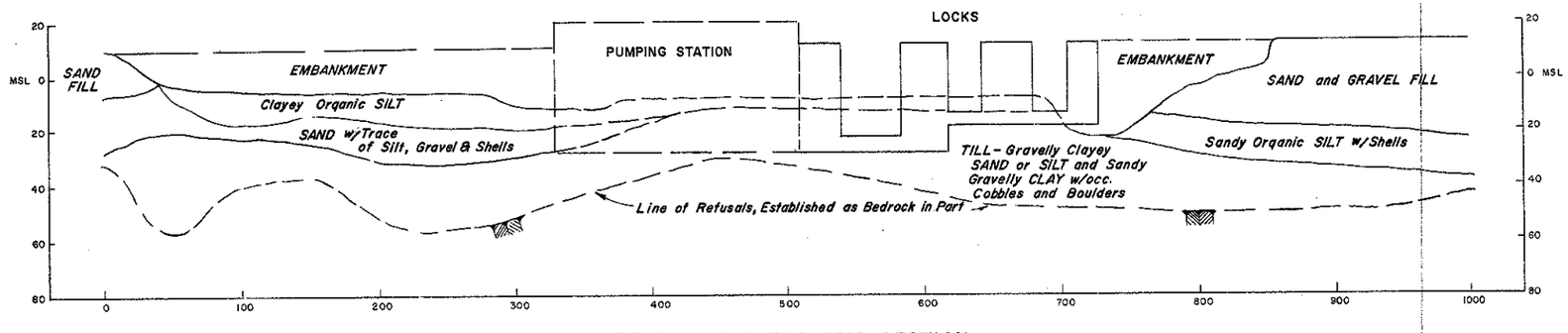
PLATE 2-15

CORPS OF ENGINEERS — U. S. ARMY



PLAN

SCALE : 1" = 40'



GENERALIZED GEOLOGIC SECTION

(LOOKING DOWNSTREAM)

LEGEND

A-3 — Locations of borings made in 1963 by American Drilling Co., Prov. R.I. for C.A. Maguire & Associates.

FD-3 — Locations of borings made in 1970 by Corps of Engineers, N. E. Div.

Location of Geologic Section.

NOTE:

Elevations in plan refer to Metropolitan District Commission Base.

DATUM RELATIONSHIP

105.65 — M.S.L., U.S.C. & G.S. / M.D.C. BASE

GRAPHIC SCALES

1"=40' 40' 0 40' 80'

CHARLES RIVER LOCKS & DAM

PLAN OF EXPLORATIONS AND GEOLOGIC SECTION

CHARLES RIVER MASSACHUSETTS

PLATE 2-16

CORPS OF ENGINEERS — U. S. ARMY

B.H. CT-1

115.9 / 114.9

Road Pavement; Cobbles

Gray-Brown fine SAND, little fine to medium Gravel, trace Silt - FILL

108.9

Gray - Brown fine SAND, some fine to med. Gravel; brick, wood & asphalt chips

98.9

Gray fine SAND and SILT; little fine gravel

92.4

Gray-Brown fine SAND and Clayey SILT, some fine to medium gravel

72.9

Brown Gray Clayey SILT, some fine to medium SAND, little fish Gravel

73.9

**108/10" — Refusal at 42'-0"

Date Completed 4/17/63

B.H. CT-2

116.1 / 114.8

Blacktop, Cobble & timber Pavement

Void under Roadbed

108.4

Gray Black Clayey ORGANIC SILT, little fine Sand; Shells

96.1

Dark Gray Fine to coarse SAND, some Silt, little medium Gravel

89.6

Yellow Brown fine to coarse SAND, little Clayey Silt, little fine to med. Gravel

84.6*

Yellow Brown Clayey SILT, some fine to medium Sand, little fine Gravel

79.1

B.H. CT-2 (Cont.)

Gray Clayey SILT, some fine to med. Sand, little fine to med. Gravel; cobbles

Boulder @ 56'6"

TOP OF ROCK 67'5"

Gray SILTSTONE; soft & seamy 4, 5, 5, 6, 7, Min./Ft.

43.7

Bottom of Boring 72'-5"

Date completed 3/10/63

B.H. CT-3

115.6

2" Black Top Pavement / 7" concrete / 3" wood

Void under road

101.3

Gray Black ORGANIC SILT, little fine Sand, trace fine Gravel

Gray fine to med. SAND, some Silt, little fine to med. Gravel

83.6

Yellow Brown Clayey SILT, and fine to med. SAND, little fine Gravel

72.6

Gray Clayey SILT, little fine to coarse Sand, little fine to med. Gravel; Cemented at 46'0"

65.6

**100/0" — Refusal at 50'-0"

Date completed 4/10/63

B.H. CT-4

116.2 / 114.2

Road Pavement; Cobbles & wood

100.2

Gray Black Clayey ORGANIC SILT, little fine Sand; wood chips

92.2

Gray fine SAND, some Silt, trace fine gravel; shells

Gray Brown Clayey SILT, some fine Sand, little fine to medium Gravel

77.2

Yellow Brown Clayey SILT, little fine to med. Sand, trace fine Gravel; Cemented at 45'0"

69.2

**108/10" — Refusal at 47'-0"

Date completed 4/16/63.

B.H. E-1

116.3 / 114.6

Blacktop, Cobblestone & timber pavement

AIR VOID

100.6

Gray Black Clayey, ORGANIC SILT, trace fine Sand

89.3

Gray fine to med. SAND, trace fine to coarse Gravel, and Silt; shells

76.3

NR

73.8

Yellow Brown Clayey SILT, little fine to coarse Sand, little fine to coarse Gravel

67.3

Gray fine to med. SAND, some Clayey Silt to fine Gravel

49.8

Bottom of Boring 66'-8"

Date completed 4/6/63

B.H. E-3

119.8 / 117.8

ROAD PAVEMENT Cobbles & wood

AIR VOID

97.8

Gray Black Clayey ORGANIC SILT, little fine Sand

89.8

Gray fine to coarse SAND, little fine Gravel & Silt; shells

83.8

Brown-Gray silty CLAY, little fine Sand, trace med. Gravel

80.8

Gray-Brown fine SAND, some Clayey Silt, little fine to medium Gravel

Becoming cemented at El. 76.0

66.8

Gray SILTSTONE, very soft & seamy 3, 3, 2, 3, 4, 3 Min./Ft.

61.8

50/NP — Refusal at 58'-0"

Date completed 4/25/63

B.H. E-4

113.4 / 111.4

ROAD PAVEMENT, cobbles, wood

AIR VOID

96.4

Gray Black Clayey ORGANIC SILT, little fine Sand; shells

94.9

Yellow Brown silty CLAY & fine SAND, little fine to med. Gravel

Becoming Cemented at El. 84.0

76.4

110/ — Refusal at 37'-0"

Date completed 4/26/63

B.H. E-7

95.0

Gray Black Clayey ORGANIC SILT, trace fine Sand; shells

89.0

Yellow Brown Silty CLAY, little fine to coarse Sand, trace fine Gravel; cobbles

76.5

Gray Brown Clayey SILT, little fine to coarse Sand and Fine Gravel; cobbles

Becoming Cemented at El. 70.0

58.25

**100/10" — Refusal at 36'-9"

Date completed 4/17/63

B.H. D-9

120.3 / 117.3

6" Asphalt; cobbles, wood, boulders

AIR VOID

110.3

NR

Stone Rip-Rap

107.3

Brown fine to med. SAND, some fine to coarse Gravel, trace Silt

Brown medium to coarse SAND, little fine Gravel

87.3

Gray Black ORGANIC SILT, some fine Sand; shells

73.3

Gray fine SAND, little Organic Silt; shells

67.3

Yellow Brown Clayey SILT, little fine Sand, little fine Gravel

56.3**

100/0" — Refusal at 64'-0"

Date completed 4/3/63

B.H. D-10

119.0 / 117.5

6" Asphalt; cobbles & wood; FILL

Brown fine SAND, some fine Gravel, little Silt

109.0

Brown coarse to fine SAND, little fine to coarse Gravel; wood chips

101.0

Brown coarse to fine SAND, little fine to medium Gravel

96.0

Gray medium to fine SAND, little fine Gravel trace Silt

Gray Black ORGANIC SILT, little fine Sand trace fine Gravel; shells

86.0

Gray fine to medium SAND, some fine to medium Gravel, little Silt

71.0

Brown Gray fine SAND and SILT, some Clay & fine Gravel

62.0

57.0**

100/0" — Refusal at 62'-0"

Date completed 4/9/63

B.H. D-11

117.6

6" Asphalt; cobbles, brick; FILL

Brown fine SAND, some fine Gravel, little Silt

104.6

Brown medium to fine SAND, some fine Gravel, trace Silt

90.8

Gray medium to fine SAND, little Silt, trace fine Gravel

82.6

Black ORGANIC SILT, trace fine sand; wood chips

67.6

Gray fine to med. SAND some Silt, little fine Gravel

Gray fine to med. SAND and Clayey SILT little fine Gravel

65.8

62.6**

100/0" — Refusal at 55'-0"

Date completed 4/10/63

B.H. CT-4 (continued)

FD-1
10-3-70
El. 98.6

No recovery

3.0

Gravel & Brick FILL

6.0

Black Silty Sandy GRAVEL w/pcs Shell, Brick & Oil odor, pcs. of wood (FILL)

8.0

Sample drive

14.4

Black, Clayey Org. SILT, w/ Shells pcs. wood and Oil odor

18.0

Black silty Sandy GRAVEL, oil odor

Black to gray organic silty sandy CLAY w/ shells, oil odor

23.5

Grey & black silty gravelly SAND & organic gravelly silty SAND w/ pcs. wood, shells & oil odor

Dk. gray & gray brown gravelly clayey SAND, w/occ. pc. large gravel (TILL) density = 146.3 pcf

36.0

Gray & gray brown silty, sandy, gravelly CLAY (TILL)

49.0

Core drilled cobbles & till

44.5

Gray brown sandy, gravelly CLAY (TILL)

51.5

Core drilled cobbles & till

52.5

Cobble frags.

53.4

Weathered rock

20% Rec

ARGILLITE, light gray, soft to moderately hard, soft decomposed zone 53.4'-57.4' and 70.0-72.6'

68%

74%

94%

41%

Core drilled w/ BX & AX "M" series Bits. AX flush joint casing used dur to caving at 53.4-57.4' No loss of drill water

72.6

BORING LEGEND (BH-)

Sample Number / Elevation — 55.5

Boring Number

Depth

Description of Strata

Water Level

Blows per 6 inches on standard 2 inch O.D. sampling spoon using 140 lb. weight falling 30 inches, unless otherwise noted.

Blows per foot on 2½ inch size casing using 300 lb weight falling 24 inches, unless otherwise noted.

Rock drilling minutes per foot

(No recovery)

Top of Rock 17'-0"

1, 3, 3 etc.

Description of Rock

Indicates push by the Driller on sampling spoon or casing.

Indicates weight of hammer on sampling spoon or casing.

Indicates blows per 6 inches on open-end "A" rod 1⅜ inch O.D. using 140 lb weight falling 30 inches.

Indicates blows per 6 inches on open end "A" rod 1⅜ inch O.D. using 300 lb weight falling 24 inches.

Bottom of Boring 20'-1"

Date Completed 12-28-60

BORING NOTES (FD-1)

Drive-sampling continuously made using 5 foot solid spoon of 2" and 1¼" I. D. driven by a drop weight of 350# falling about 30 inches

CHARLES RIVER LOCKS & DAM

RECORD OF SELECTED EXPLORATIONS

CHARLES RIVER — MASSACHUSETTS

PLATE 2-17

APPENDIX A

LETTERS OF COMMENT AND CONCURRENCE

APPENDIX A

LETTERS OF COMMENT AND CONCURRENCE

CHARLES RIVER DAM

CHARLES RIVER BASIN, MASSACHUSETTS

CONTENTS

FRANCIS W. SARGENT
GOVERNOR

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE DEPARTMENT
STATE HOUSE, BOSTON 02133

March 3, 1971

Dear Colonel Bane:

Thank you for your letter of December 31, 1970, advising me of the current status of the Charles River Dam Project.

Your cooperative effort with the Metropolitan District Commission is another example of the importance of close relationships between Federal and State agencies.

I am most interested in the Project's progress, for it is of high priority from the point of view of both improved area environment and better metropolitan transportation.

Again, thanks for writing.

With best wishes,

Sincerely,

Francis W. Sargent

Colonel Frank P. Bane
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

EXHIBIT 1

The Commonwealth of Massachusetts
Metropolitan District Commission
20 Somerset Street, Boston 02108

September 27, 1971

Re: NEDED-E

Mr. John Wm. Leslie
Chief, Engineering Division
Department of the Army
N. E. Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

Reference is made to the September 21, 1971 letter of your project engineer, C. N. Ciriello, concerning the Charles River Locks and Dam Project.

I am sure that you are aware that our constant thoughts on this matter are being passed on through consultation by M.D.C. engineering personnel with employees of your staff as well as Charles A. Maguire & Associates, Inc., the consultants for the project. It is felt that continual liason will be necessary in the future as the work progresses. I am setting forth some of the major items which we have been particularly interested in and have either passed on our comments or which we now suggest should be taken into consideration.

(1) The operating experience by the Park Engineering Division personnel at the Amelia Earhart Dam and Locks together with their suggestions for the Charles River project design.

(2) The coordination of this project with the Boston and Cambridge marginal conduits and pumping station and treatment facility through our mutual consultants Charles A. Maguire & Associates, Inc.

(3) The coordination of the proposed extension of highway and bridge construction in the area between Leverett Circle and City Square, Charlestown over the new dam with our engineering

division and the New England office of Alan M. Voorhees and Associates.

(4) A coordinated effort toward the procurement of pumping equipment, and possible cancellation of our previous contract with Fairbanks-Morse through our legal counsel, Mr. John Wright.

(5) The extent of landtakings necessary with M.D.C. real estate and planning personnel.

It is hoped that continued coordination will be maintained as the final design progresses.

The Metropolitan District Commission concurs with the project to date as described in your letter. The Metropolitan District Commission is still willing to participate in the construction of the proposed project and will provide the requirements of local cooperation and reimbursement.

Very truly yours,

JOHN W. SEARS
COMMISSIONER

hh

EXHIBIT 2

PAGE 2 OF 2

The Commonwealth of Massachusetts
Metropolitan District Commission
20 Somerset Street, Boston 02108

rd Whitmore, Jr.
Commissioner

March 25, 1969

Colonel Frank P. Bane, Division Engineer
N. E. Div.,Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: NEDED-R

Dear Colonel Bane:

Thank you very much for your letter of March 6, 1969.

The following is an extract from the records of the Commission meeting held on March 20, 1969:

"Letter of U. S. Army, Corps of Engineers, March 6, 1969, requesting certain Commission assurances regarding the proposed Charles River Dam Project.

The Commission V O T E D to grant the assurances requested; Commissioner authorized to advise U. S. Army Engineers accordingly."

As authorized by said Vote:

This will certify assurance of the capability and willingness of The Metropolitan District Commission, Commonwealth of Massachusetts, to provide the requirements of local cooperation or reimbursement outlined in your March 6, 1969 letter of inquiry regarding the Charles River Dam project. These requirements will be provided at the time requested by the Division Engineer, U.S. Army Corps of Engineers, in accordance with applicable legislative authority governing the project.

I wish to thank you for your continued interest and assistance in this matter.

Sincerely yours,

Howard Whitmore, Jr.

HOWARD WHITMORE, JR.
Commissioner

HW/o

EXHIBIT 3

The Commonwealth of Massachusetts
Water Resources Commission
State Office Building, Government Center
100 Cambridge Street, Boston 02202

OFFICE OF THE DIRECTOR
DIVISION OF WATER
POLLUTION CONTROL

January 12, 1971

Mr. John W. Leslie
Chief, Engineering Division
Corps of Engineers, N.E. Division
424 Trapelo Road
Waltham, Massachusetts 02154

RE: Boston Charles River
Proposed Charles River Dam

Dear Mr. Leslie:

Reference is made to your letter of January 6, 1971, requesting our comments on the proposed Charles River Dam. By letter dated December 16, 1970 to Commissioner Brownell of the Massachusetts Department of Natural Resources, you enclosed an "Environmental Statement" relative to this project. A copy of the statement was furnished this Division for comment. In paragraph 3a (2) of the statement, it is suggested that sewers now discharging into the Charles River downstream of the existing dam will be relocated to discharge further downstream, below the new dam, thus preventing pollution of impounded waters and bringing discharged material under the influence of more positive downstream tidal action. This Division concurs with the FWPCA (now FWQA) that a total system of collection and treatment below Warren Avenue Bridge be provided rather than merely transferring the point of discharge of untreated wastes.

I appreciate the opportunity to comment on this project.

Very truly yours,

Thomas C. McMahon
Director

TCM/WAS/ch

EXHIBIT 4

The Commonwealth of Massachusetts
Water Resources Commission
Leverett Saltonstall Building, Government Center
100 Cambridge Street, Boston 02202

OFFICE OF THE DIRECTOR
DIVISION OF WATER RESOURCES

January 19, 1971

Mr. John Leslie, Chief
Engineering Division
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Re: Charles River Dam

Dear Mr. Leslie:

Your request of January 6, 1971 for comment on the Charles River Dam proposal has been received and reviewed by this office. Since the proposal is similar to that included in the Interim Report on the Charles River, we refer you to our letter of July 25, 1968 to General F.J. Clarke, Acting Chief of Engineers in Washington. The letter, submitted in response to the Interim Report, concurred with the project as proposed. Subsequently, on November 4, 1968, we received a copy of House Document #370, the letter and report on the Interim Report of the Lower Charles River Watershed. No request was made for comment on this document.

In response to your current request, we concur generally with the Charles River Dam proposal as described in your letter of January 6, 1971. However, we would like to point out that in House Document #370, the cost of the fish ladder at the dam is estimated at $10,000. The Massachusetts Division of Marine Fisheries has suggested a current cost of fishway construction at from 3 to 5 thousand dollars per vertical foot. Therefore the cited figure of $10,000 appears to be quite unrealistic. We anticipate that this cost estimate will be revised and reflected in the General Design Report which is scheduled for completion in April 1971. We also

EXHIBIT 5

PAGE 1 OF 2

again request that final design and initial construction of the fish ladder be closely coordinated with the Division of Marine Fisheries.

We appreciate the opportunity to comment on the proposal.

Very truly yours,

Charles F. Kennedy
Director & Chief Engineer

CFK:CEW/kmk

Arthur W. Brownell
Commissioner

EXHIBIT 5
PAGE 2 OF 2

AMES M. SHEPARD
DIRECTOR

The Commonwealth of Massachusetts

Division of Fisheries and Game

Leverett Saltonstall Building, Government Center
100 Cambridge Street, Boston 02202

January 29, 1971

Mr. John Wm. Leslie, Chief
Engineering Division
U.S. Army, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

This letter extends our comments relative to the proposed Charles River Dam, please be advised that the Division of Fisheries and Game concurs with said project.

We anticipate that the subsequent change in water quality, as foreseeable with the completion of this project, should enhance the warm-water fisheries within this reach of the Charles River. Also, the proposed fish passage facility should improve the present smelt and alewife migrations. The Division further realizes that a potential exists for American shad restoration in the Charles, this project should enhance that objective.

We appreciate the opportunity to review and comment upon this project proposal.

Very truly yours,

James M. Shepard

James M. Shepard
Director

EXHIBIT 6

The Commonwealth of Massachusetts

Department of Public Works

Office of the Commissioner

100 Nashua Street, Boston 02114

March 4, 1971

John Wm. Leslie, Chief Engineering Division
U. S. Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts

Dear Mr. Leslie:

This is in reference to your January 6, 1971 letter requesting our comments on the proposed Charles River dam to be constructed in the City of Boston and now being designed by C. A. Maguire & Associates.

Please be advised that we have reviewed the small scale general site plans and typical sections and, in general, they do not offer any conflicts with existing or proposed facilities of this Department.

However, we should like to bring to your attention that existing drainage facilities of the Department discharge into the Charles River just upstream from the dam site. We would, therefore, like to review in detail plans and hydraulic reports as to how these drainage facilities will be accommodated once the dam is built.

Also, regarding the viaduct to be constructed above the dam, we would like more details on the extent of this work and when and by whom it would be constructed.

Very truly yours,

EDWARD J. RIBBS
COMMISSIONER

EXHIBIT 7

NEW ENGLAND RIVER BASINS COMMISSION
55 COURT STREET · BOSTON, MASSACHUSETTS 02108
PHONE: (617) 223-6244

January 11, 1971

Mr. John Wm. Leslie
Chief, Engineering Division
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts

Dear Mr. Leslie:

Reference is made to your letter of January 6, 1971, concerning the proposed new dam on the lower Charles River with its appurtenant locks, flood water pumping station, fish ladder and viaduct.

I am pleased to hear that the proposed project is so well along that you expect to have the general design report completed this coming April. I firmly believe after all the controversy surrounding this project that it will represent a substantial improvement for the area. I have been informed that it will greatly alleviate the lower basin flood problem, improve water quality in the basin by reduction in saltwater intrusion, vastly improve the lock capacity, provide a badly needed fish ladder and a necessary new bridge to replace the destroyed Warren Avenue Bridge.

We will be careful to make particular mention of the project for construction in our next priorities report.

Thank you for the opportunity to comment on this project.

Yours very truly,

Frank Gregg
Chairman

FG/n

EXHIBIT 8

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
FEDERAL WATER QUALITY ADMINISTRATION
New England Basins Office
240 Highland Avenue
Needham Heights, Massachusetts

25 January 1971

Mr. John Wm. Leslie, Division Engineer
Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

Reference your NEDED-E, 6 January 1971, Charles River Dam. Construction of the proposed Charles River Dam will require some dredging of highly organic materials. During the construction phases, local temporary pollution will likely occur. The project area should be enclosed to avoid spreading of pollutants.

The disposal site for the dredged materials is an equally important consideration. Recently new criteria have been adopted by the Environmental Protection Agency to determine the acceptability of materials for open water disposal. The disposal location in part will be based on sediment analyses which should be coordinated with our office. To insure that only minimum adverse effects occur, the dredging and disposal operations should be strictly supervised.

The Boston Marginal Conduit intercepts combined sewage from the West Side Interceptor and Stony Brook System. Depending on the tide level and intensity of rainfall, overflows from the Boston Marginal Conduit discharge to tidewater below the present dam, to the Charles River Basin or to both. Additional overflows of combined sewage occur between the existing and the proposed dam from sewers in Cambridge, Somerville, Charlestown and the North End of Boston.

The Charles River is classified as "C" above the existing dam and "SC" in the tidal portion below the dam. Class "C" and "SC" waters have good aesthetic value and are suitable for recreational boating and as a habitat for wildlife and common food and game fish indigenous to the region. The present occurrence of overflows of combined sewage to these waters prevent the water quality standards from being met.

The proposed construction is closely interrelated to this problem. Consideration should therefore be given, at this time, to a total system that would reduce overflows to the Charles River from the Boston Marginal Conduit and Stony Brook System, and overflows that now occur between the existing and the proposed dam to levels consistent with other Charles River combined sewer abatement projects (five-year frequency rainfall). To protect or enhance the water quality of Boston Harbor, consideration should also be given to intercepting overflows that occur below the proposed dam from Charlestown and the West Side Interceptor and provide adequate treatment to the overflow before discharge to the Harbor. The present proposal, as we understand it, does not adequately cover these factors.

We recommend that the project be further coordinated with the Massachusetts Division of Water Pollution Control and local interests to insure that provision is made in the design phases of the project which would allow for an adequate combined sewer abatement plan.

FOR THE REGIONAL DIRECTOR:

Sincerely yours,

Bart Hague

Bart Hague
Chief of Planning

EXHIBIT 9
PAGE 2 OF 2

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
Division of River Basin Studies
55 Pleasant Street
Concord, New Hampshire 03301

February 26, 1971

Division Engineer
New England Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This letter summarizes the results of the meeting held at your office on February 17, 1971, concerning the Charles River Dam fishway. The purpose of the meeting was to bring together the several agencies involved to review proposed fish passage facilities to be included in the project plan. Persons who attended the meeting are listed on the attached sheet.

Mr. Rizzo described design features and operation of the fish passage facilities we recommend for the proposed project. This plan for the fishway is being developed in coordination with the Massachusetts Division of Marine Fisheries and the Massachusetts Division of Fisheries and Game.

The fish passage facilities include:

a. A conventional weir type fishway to be operated when the tide level on the downstream side of the dam is at or below the basin level on the upstream side of the dam. This occurs for approximately 7-1/2 hours every tidal cycle (12-1/2 hours long).

b. A combination sluiceway and fish lock which will provide attraction water for the fishway and also provide for upstream fish passage during periods when the tide is above basin level. The fish lock will operate for approximately 5 hours every tidal cycle.

c. Railings and walkways have been provided to accommodate public viewing of fish migrations through the passage facilities.

d. Both the fishway and fish lock will be utilized for downstream passage when the tide is at or below the basin level.

The fish passage facilities we recommend are a modification of the fishway design which was included in your project plans.

We understand that fish passage facilities discussed during this meeting are acceptable and will be included in your General Design Memorandum. We agreed

EXHIBIT 10

PAGE 1 OF 3

to submit a report by April 1 including estimates of anticipated fish passage, recreation day values, and a brief description of fishway operation requirements. Close coordination between Mr. Rizzo of our Regional Office, Mr. Dunn of Charles A. Maguire Associates (consultant engineers), Mr. Baron of the Metropolitan District Commission, the Massachusetts Divisions of Marine Fisheries and Fisheries and Game, and your office will be continued to fit the design and operating procedures into the project plan.

We understand that you plan to add additional sluices to the proposed design of the dam to facilitate discharge of surplus water. These sluices will be located at the north side of the dam and one of the sluices could be located at an elevation to discharge surface waters. We recommended that the upper level sluice also be used as the combination sluiceway and fish lock. Mr. Rizzo's plan can be further modified for this purpose.

Mr. Baron suggested the possibility of transposing the fishway and fish lock units and moving them to a point near the north bank to improve the view for spectators watching fish moving through the fishway. It appears that this is possible and details will be worked out with Mr. Rizzo.

Since the project and the fishway will be operated by the MDC, Mr. Baron requested that this Bureau and State agencies assist in preparing a fishway operations manual and assist in fishway operations as necessary. This Bureau, in cooperation with the Massachusetts Division of Marine Fisheries and Division of Fisheries and Game, agreed to assist in preparing detailed operating instructions during final detailed design stages and provide guidance to fishway operators as necessary.

Please advise us if the above understandings are incorrect. We appreciate your cooperation and plan to assist you as necessary in the design and operation of an effective fishway.

Sincerely,

Norrel Wallace

Norrel F. Wallace
Supervisor
Concord Area Office

Attachment

cc: RBS, BSF&W
B. Rizzo, BSF&W
L. Bridges, Mar. Fish.
A. Neill, Fish & Game
T. Baron, MDC

EXHIBIT 10

PAGE 2 OF 3

Meeting on February 17, 1971

Fish Passage - Charles River Dam

Norrel Wallace	BSF&W
Edwin Robinson	BSF&W
Benedetto Rizzo	BSF&W
Joseph Bergin	Mass. Div. of Fisheries & Game
Allen Peterson	Mass. Div. of Marine Fisheries
Joseph DiCarlo	Mass. Div. of Marine Fisheries
Thomas Baron	Metropolitan District Commission
Clinton Watson	Mass. Water Resources Commission
Carmen Ciriello	Corps of Engineers
Frank Notardonato	Corps of Engineers
Julius Mikolaities	Corps of Engineers
Edward Dunn	Charles A. Maguire Associates

EXHIBIT 10

PAGE 3 OF 3

ENVIRONMENTAL PROTECTION AGENCY
REGIONAL OFFICE
JOHN F. KENNEDY FEDERAL BUILDING
GOVERNMENT CENTER
BOSTON, MASSACHUSETTS 02203

Division of Water Hygiene

February 3, 1971

Mr. John Wm. Leslie, Chief, Engineering Division
Department of the Army, NED, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear John:

This will refer to your letter of 6 January 1971 to Mr. Keene and it is requested that, in the future, similar material be sent to me directly. The reason for this is that the new organization of the Environmental Protection Agency places the responsibility for work of this kind in this office.

I am, of course, not unfamiliar with the proposal which you describe as it was the subject of many discussions at meetings of the Charles River Coordinating Committee. The stated purposes of the project are flood control, navigation and highway passage. Of these, the first is closely related to protection of the public health and this office views any measures for mitigating flood damage as being in the best interests of the public health. At times of flooding, public health is in danger for many reasons, notable among these are the occurrence of mud and debris, creation of conditions conducive to rodent infestation and the displacement of people with all of the attendant trauma associated therewith.

In this particular instance, navigation and highway passage are not considered to be directly related to health benefits.

It is our opinion that there should be some improvement of water quality in the Charles River above the new dam but whether or not this would be significant, we are unable to say.

This office does not see any negative health values from the proposed construction.

Sincerely,

Floyd

Floyd B. Taylor
Regional Representative
Division of Water Hygiene, Water Quality Office
Environmental Protection Agency

EXHIBIT 11

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
FEDERAL BUILDING
1421 CHERRY STREET
PHILADELPHIA, PENNSYLVANIA 19102

IN REPLY REFER TO:

February 11, 1971

Colonel Frank P. Bane
Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Bane:

This is to acknowledge John Leslie's January 26, 1971 letter requesting our comments on the proposed Charles River Dam in Boston, Massachusetts. We have reviewed the project description and believe that the proposed project would enhance outdoor recreation opportunities and help to meet existing and projected boating needs.

The 1970 Outdoor Recreation Study of the Charles River Watershed by the Massachusetts Department of Natural Resources includes the Charles River Dam in the list of Corps' impoundments that presently offer under-utilized outdoor recreation and community beautification opportunities. The project development would also be in accord with the Massachusetts State Outdoor Recreation Plan which discusses priorities in the metropolitan Boston area.

Thank you for the opportunity to comment.

Sincerely yours,

Rolland B. Handley
Regional Director

By Earl C. Nichols
Earl C. Nichols

EXHIBIT 12

APPENDIX B

PROJECT COST AND COST ALLOCATION

APPENDIX B

PROJECT COST AND COST ALLOCATION

CHARLES RIVER DAM

CHARLES RIVER BASIN, MASSACHUSETTS

CONTENTS

LIST OF TABLES

APPENDIX B

PROJECT COST AND COST ALLOCATION

CHARLES RIVER DAM

CHARLES RIVER BASIN, MASSACHUSETTS

1. GENERAL. The Charles River Dam project will be located across the Charles River in Boston, Massachusetts about 2,250 feet downstream of the existing Charles River Dam. The project is designed for multiple use including flood control, navigation and highway transportation. Allocation of costs is required in order that all authorized purposes served by the project share equitably in the joint savings of multiple-purpose construction.

2. METHOD OF ALLOCATION OF COSTS. - Cost allocation studies for this project were made using the Separable Costs-Remaining Benefits Method (SCRB) as prescribed in Paragraph 1-09 of EM 1160-2-101. The special application and procedure of allocating dual joint-use costs were made by the method recommended in the report on "Proposed Practices for Economic Analysis of River Basin Project", dated May 1958, prepared by the Subcommittee on Evaluation Standards for the Inter-Agency Committee on Water Resources.

3. PROJECT DESCRIPTION. - This project is fully described in the text of this General Design Memorandum. Specific requirements are the pumping station and equipment provided for flood control, the two small boat locks and appurtenant materials and equipment provided for recreational navigation, and the vehicular viaduct and related construction features provided for highway transportation across the Charles River. Sewerage modifications consisting of the construction of the Boston and Cambridge marginal conduit, utility relocations and sewage pumping station are required only for flood control and navigation. Therefore, these costs are allocated as dual joint-use for these project purposes. All other project features are joint-use. A breakdown of costs into specific, dual joint-use and joint-use is shown on Table B-5.

4. OPERATIONAL REQUIREMENTS. - Upon completion of the Charles River Locks and Dam, the Metropolitan District Commission of Massachusetts will operate and maintain all features of the project. Details of operational procedures are included in the main text of this report. In general, the project will be primarily operated: (1) to maintain

a fairly constant fresh water Basin level (approximate elevation 108.0 feet, MDC base) during non-flood periods; (2) to keep the Basin level below damage state during flood periods; (3) to serve the navigational requirements of the Basin. In addition, fish passage facilities will be operated for anadromous fish.

5. PROJECT COSTS AND ANNUAL CHARGES. -

a. Construction Costs. - The total cost of the project, including lands and damages is estimated at $37,800,000 at 1971 price levels. A detailed breakdown is shown in Table B-4. The feature of lands and damages includes the additional costs for resettlement and acquisition as required under the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970", P. L. 91-646. The cost estimate also reflects a slight increase over the last reported estimate in the PB-3 of 1 July 1971 in which the estimate was $37,600,000.

b. Interest During Construction. - Accrued interest during construction is computed on the basis of a three and one-half year construction period. This was derived by multiplying the total construction expenditures by the 3.25 percent interest rate and by one-half of the construction period in years.

c. Annual Charges. - A breakdown of annual charges is shown in Table B-5.

(1) Interest and Amortization. - The flood control features of the project are considered to have an economic life of 100 years. Interest is computed at 3.25 percent amortized over a 100-year period. The navigation and highway transportation features are considered to have an economic life of 50 years. Interest for these features is computed at 3.25 percent amortized over 50 years and converted to a 100-year series.

(2) Operation and Maintenance. - This item is estimated on the basis of the annual cost experienced at the Mystic River Locks located less than 3 miles north of the project site. The Mystic facility is similar in scope to the Charles River Locks and Dam and is staffed and operated by the Metropolitan District Commission, the same agency that will be operating the Charles River Project. Included are costs for maintenance of the project structures and for operation of the multiple-purpose project features. In determining the operation and maintenance annual charges, the flood control portion is based on a 100-year economic life and the navigation and highway transportation features are based on a 50-year economic life converted to a 100-year series.

(3) Major Replacements. - An allowance is made for the replacement of items deemed to have a usable life less than 100 years for the flood control features and less than 50 years for the navigation and highway transportation features. Similar to the operation and maintenance costs, annual charges for the 50-year period were converted to a 100-year series.

(4) Loss of Productivity on Land. - The item allows for the loss of taxes on lands transferred to state ownership for the project. The net loss in productivity was computed by taking the estimated market value of lands provided by non-Federal interests times the difference in non-Federal and Federal financial and economic interest rates.

Land Values (including contingencies)		$ 318,000
Non-Federal Interest Rate	6-3/4%	
Federal Economic Interest Rate	- 3-1/4%	
Differential	3-1/2%	x .035
Net Loss in Productivity		$ 11,130
	Use	$ 11,000

6. PROJECT BENEFITS. - The dual-purpose and single-purpose projects represent the most economical alternatives in which the benefit derived for each of the purposes is the same as the benefit of the respective purpose in the recommended project. The alternatives are considered at the same site as the recommended three-purpose project.

a. Flood Control Benefits. - The total average annual flood control benefits are estimated at $2,235,000 and result from the following:

(1) Tangible Benefits. - Tangible average annual flood control benefits and average annual benefits for future growth projected to take place in the lower Charles River Basin are estimated at $1,600,000.

(2) Higher Utilization Benefits. - Average annual benefits derived from higher utilization of basement space in commercial and industrial properties, which are currently under-utilized because of the threat of flooding, are estimated at $480,000.

(3) Advance Replacement Benefit. - The average annual benefits secured by the advance replacement of the existing dam and creditable to the flood control portions of the new dam are estimated at $155,000.

b. Navigation Benefits. - Average annual benefits for navigation are attributable to increased recreational boat usage of the locks, an increase in the recreational boat fleet in the lower basin and the availability of a harbor of refuge in the area of the new pool between the two dams. These benefits, considered for a 50-year period, were estimated at $490,000. Spread over a 100-year period, these benefits computed as shown in the text of this report amount to $408,000 annually. In addition, the average annual benefits secured by the advanced replacement of the existing navigation lock and creditable to the navigation portion of the new facility are estimated at $76,000. Therefore, the total average annual benefits attributed to navigation are $408,000 plus $76,000 or $484,000.

c. Highway Transportation Benefits. - Highway transportation benefits are estimated at $80,000. These benefits have been measured by equating them to the annual cost of a single-purpose highway constructed at the same project site.

d. Redevelopment Benefits. - Construction and subsequent operation and maintenance of the project will provide work opportunities for the unemployed or underemployed labor force from the Boston Labor Market Area which includes localized areas within the City of Boston with unemployment rates well above the national average. These pockets of unemployment are inhabited principally by minority groups. Most of the skilled and unskilled labor will most likely be from these areas. In addition areas to the north and south of the project site are classified as Title IV Redevelopment areas. These are located within convenient commuting distance of the project and will also realize employment benefits during construction. Total annual redevelopment benefits estimated to accrue from construction of the project amount to $136,000.

7. COST ALLOCATIONS. - Costs to the project purposes were allocated by the SCRB method. Table B-6 outlines in detail the cost allocations and Table B-1 summarizes the results of allocations for the recommended project. The total investment includes the first cost plus interest during construction.

TABLE B-1

SUMMARY OF COST ALLOCATIONS

Purpose	First Cost	Total Investment	Annual Charges
Flood Control	$26,560,000	$28,069,000	$1,178,000
Navigation	9,940,000	10,506,000	441,000
Highway Transportation	1,300,000	1,375,000	62,000
Totals	$37,800,000	$39,950,000	$1,681,000

8. COMPARISON OF BENEFITS AND COSTS. - A comparison of benefits accruing to each project purpose with its allocated costs is as shown in Table B-2.

TABLE B-2

ECONOMIC ANALYSIS

Purpose	Annual Benefits	Annual Costs	Benefit Cost Ratio
Flood Control	$2,235,000	$1,178,000	
Navigation	484,000	441,000	
Highway Transportation	80,000	62,000	
Totals	$2,799,000	$1,681,000	1.67
Redevelopment	136,000	-	
Totals	$2,935,000	$1,681,000	1.74

9. APPORTIONMENT OF COSTS AMONG INTERESTS. -

a. Federal. - Flood control benefits realized from construction of recommended project are local protection in nature. Accordingly, the Federal Government will bear all first costs allocated to flood control except for cost of lands and damages and relocations, which are responsibility of local interests in accord with the 1936 Flood Control Act, as amended. Navigation benefits are recreational in nature and under existing policy project costs allocated to navigation, excluding lands and damages and relocations, are shared on a 50 percent basis between Federal and non-Federal interests.

b. Non-Federal. - In addition to 50 percent of the allocated project costs for recreational navigation, non-Federal interests will pay the entire costs of lands and damages and relocations. The transportation features have been included at local request and non-Federal interests will pay the entire cost allocated to highway transportation. Since the local protection works will be operated and maintained by the Metropolitan District Commission, State of Massachusetts, upon completion, non-Federal interests will pay 100 percent of the annual operation and maintenance and replacement costs for the entire project.

c. Summary of Apportionment of Costs Among Interests. A summary of the apportionment of costs among interests is shown in the following table:

TABLE B-3

COST APPORTIONMENT AMONG INTERESTS

Project Feature	Federal	Non-Federal	Total
Lands and Damages	0	$ 400,000	$ 400,000
Relocations	0	7,100,000	7,100,000
Structures	$24,755,000	5,545,000 (1)	30,300,000
Total Project First Costs	$24,755,000	$13,045,000	$37,800,000

(1) Based on non-Federal interests bearing 18.3 percent of the cost of the structural features of the project as specifically authorized by the 1968 Flood Control Act, Public Law 90-483. This percentage was developed in the authorizing document utilizing cost apportionment principles previously stated in paragraphs a. and b.

10. COST ESTIMATES. - A summary of major construction items together with estimated first costs is given in Table B-5. Except for relocations a contingency factor of 11 percent has been used rather than the customary 15 percent because of the large amount of detailed design of the project structures has been accomplished. The contingency factor of 15 percent was used for the estimate on relocations as the design is in a preliminary stage and currently being finalized by the Metropolitan District Commission. Also included are estimates of investments, and average annual charges for the recommended three-purpose project and separate single and dual purpose alternatives computed for cost allocation purposes. The detailed cost allocation is shown in Table B-6.

TABLE B-4

DETAILED COST ESTIMATE
(1971 Price Level)

	Description	Quantity	Unit	Unit Price	Estimated Amount
01.	Lands and Damages				
	Lands, Easements, Acquisition & Severance Damages				$ 400,000
02.	Relocations				
	Water Lines	1	Job	L.S.	46,000
	Sewer & Drain Lines	1	Job	L.S.	42,000
	Railroad Track	1	Job	L.S.	4,000
	Submarine Signal, Power & Communication Cables	1	Job	L.S.	134,000
	Misc. Millers River Drainage	1	Job	L.S.	12,000
	Boston Marginal Conduit - 8' Dia. Force Main	2,020	L.F.	600.00	1,212,000
	Cambridge Marginal Conduit - 7' Dia. (Subaqueous)	1,350	L.F.	1,100.00	1,485,000
	Relief Sewers - Boston, Charlestown Overflows				
	Special Chamber	1	Job	L.S.	15,500
	7' Dia. Conduit	1,500	L.F.	500.00	750,000
	Millers River Crossing	50	L.F.	1,000.00	50,000
	Combination Overflows (5' Dia. Conduit)	80	L.F.	400.00	32,000
	Metropolitan Sewer (5' Dia. Conduit)	1,600	L.F.	400.00	640,000
	Lowell Street Connector	1	Job	L.S.	193,000
	Enlarge Sewerage Pumping Sta.	1	Job	L.S.	1,000,000
	Sub-Total				$5,615,500
	Contingencies				844,500
					$6,460,000
	Engineering & Design				320,000
	Supervision & Administration				320,000
	TOTAL RELOCATIONS				$7,100,000

TABLE B-4 (Continued)

	Description	Quantity	Unit	Unit Price	Estimated Amount
04.	**Dam**				
	Preparation of Site	1	Job	L.S.	$ 150,000
	Common Exc.(River)	7,200	C.Y.	3.50	25,200
	Common Exc.(Land)	1,500	C.Y.	2.50	3,750
	Granular Refill	68,000	C.Y.	3.00	204,000
	Granular Fill	71,000	C.Y.	3.50	248,500
	Type I Stone Prot.	400	Tons	8.00	3,200
	Type III Stone Prot.	2,600	S.Y.	48.00	124,800
	Bedding Stone	1,700	Tons	7.00	11,900
	Parking Facilities	1	Job	L.S.	79,000
	Fencing w/gates	800	L.F.	7.00	5,600
	Utilities	1	Job	L.S.	17,000
	Landscaping	1	Job	L.S.	28,000
	Fish Passage Fac.	1	Job	L.S.	242,000
	Sluiceways	1	Job	L.S.	87,000
	Force Main (8' Dia.)	1	Job	L.S.	179,000
	Sub-Total				$1,408,950
	Contingencies				191,050
	TOTAL DAM				$1,600,000
05.	**Navigation Locks**				
	Preparation of Site	1	Job	L.S.	$ 150,000
	Common Exc. (River)	95,400	C.Y.	3.50	333,900
	Cofferdam	1	Job	L.S.	2,650,000
	Type I Stone Prot.	11,200	Ton	8.00	89,600
	Type II Stone Prot.	15,000	Ton	8.00	120,000
	Fender System	1	Job	L.S.	590,000
	Concrete (2,000 psi)	10,000	C.Y.	45.00	450,000
	Concrete (3,000 psi)	49,700	C.Y.	65.00	3,230,500
	Portland Cement	332,000	Cwt.	1.60	531,200
	Steel Reinforcement	1,580	Tons	440.00	695,200
	Waterstops	34,000	L.F.	3.50	119,000
	Structural Steel (C.T.)	1	Job	L.S.	40,000
	Structural Steel (Marine)	1	Job	L.S.	60,000
	Misc. Ferrous Metals	110	Tons	2,000.00	220,000
	Misc. Non-Ferrous Metals	45,600	Lbs.	5.00	228,000
	Alum. Stairs	1	Job	L.S.	25,000
	Carp. & Millwork	1	Job	L.S.	2,700

TABLE B-4 (Continued)

Description	Quantity	Unit	Unit Price	Estimated Amount
05. Navigation Locks				
Roof Insul. & Flash.	1	Job	L.S.	$ 17,000
Metal Doors & Frames	1	Job	L.S.	2,700
Aluminum Windows	1	Job	L.S.	45,000
Glass & Glazing	1	Job	L.S.	29,000
Terrazzo Floor	1	Job	L.S.	4,300
Ceramic Tile	1	Job	L.S.	900
Metal Lath & Plaster	1	Job	L.S.	6,900
Painting	1	Job	L.S.	30,000
Acoustic Ceiling	1	Job	L.S.	700
Toilet Partitions	1	Job	L.S.	400
Hardware	1	Job	L.S.	1,400
Lockers & Benches	1	Job	L.S.	1,500
Engr. Locker House	1	Job	L.S.	22,000
Lock Pumping & Culvert System	1	Job	L.S.	600,000
Lock Gates & Operating Machinery	1	Job	L.S.	1,200,000
Hyd. Power System	1	Job	L.S.	375,000
Comp. Air System	1	Job	L.S.	30,000
Floating Mooring Bits	52	Ea.	1,200	62,400
Breasing Floats	32	Ea.	1,200	38,400
Instrumentation	1	Job	L.S.	65,000
Plumbing	1	Job	L.S.	46,000
Heat., Vent., & Air Conditioning	1	Job	L.S.	73,000
Sub-Total				12,186,900
Contingencies				1,313,100
TOTAL LOCKS				$13,500,000
08. Bridges (Viaduct)				
Steel Bearing Piles	9,000	L.F.	7.00	$ 63,000
Points for Piles	200	Ea.	60.00	12,000
Pile Load Test	1	Job	L.S.	18,000
Synthetic Resin Pavement Surf.	4,000	S.Y.	5.00	20,000
Granite Curbing	1,600	L.F.	7.00	11,200
Guard Rail	550	L.F.	5.00	2,750
Alum. Bridge Rail	1,650	L.F.	7.00	11,550
Concrete (3,000 psi)	700	C.Y.	65.00	45,500

TABLE B-4 (Continued)

	Description	Quantity	Unit	Unit Price	Estimated Amount
08.	Bridges (Viaduct)				
	Concrete (4,000 psi)	2,100	C.Y.	85.00	178,500
	Portland Cement	19,125	Cwt.	1.60	30,600
	Steel Reinforcement	190	Tons	440.00	83,600
	Structural Steel	1	Job	L.S.	250,000
	Painting	1	Job	L.S.	13,000
	Sub-Total				739,700
	Contingencies				60,300
	TOTAL BRIDGES				$ 800,000
13.	Pumping Station				
	Preparation of Site	1	Job	L.S.	150,000
	Common Excavation (River)	77,400	C.Y.	3.50	270,900
	Rock Excavation (River)	200	C.Y.	40.00	8,000
	Cofferdam	1	Job	L.S.	1,800,000
	Type I Stone Prot.	12,500	Ton	8.00	100,000
	Type II Stone Prot.	17,000	Ton	8.00	136,000
	Training Walls	1	Job	L.S.	33,000
	Concrete (2,000 psi)	1,000	C.Y.	45.00	45,000
	Concrete (3,000 psi)	20,600	C.Y.	65.00	1,339,000
	Portland Cement	122,000	Cwt.	1.60	195,200
	Steel Reinforcement	1,450	Tons	440.00	638,000
	Precast Conc. Roof Plank	1	Job	L.S.	25,000
	Precast Arch. Wall Panels	1	Job	L.S.	150,000
	Conc. Masonry Units	1	Job	L.S.	19,000
	Glazed Struct. Tile	1	Job	L.S.	11,000
	Structural Steel	1	Job	L.S.	145,000
	Bulkhead & Lifting Beams	1	Job	L.S.	103,000
	Misc. Ferrous Metals	60	Ton	2,000.00	120,000
	Misc. Non-Ferrous Metals	13,600	Lbs.	5.00	68,000
	Steel Stairs	1	Job	L.S.	20,000
	Trash Racks	1	Job	L.S.	150,000
	Carp. & Millwork	1	Job	L.S.	4,600

TABLE B-4 (Continued)

	Description	Quantity	Unit	Unit Price	Estimated Amount
13.	Pumping Station				
	Roof, Insul. & Flashing	1	Job	L.S.	$ 5,000
	Waterproof & Caulking	1	Job	L.S.	10,000
	Metal Doors & Windows	1	Job	L.S.	2,300
	Alum. Windows	1	Job	L.S.	255,000
	Glass & Glazing	1	Job	L.S.	51,000
	Quarry Tile	1	Job	L.S.	43,000
	Ceramic Tile	1	Job	L.S.	1,500
	Painting	1	Job	L.S.	18,000
	Acoustic Tile	1	Job	L.S.	500
	Conc. Coating	1	Job	L.S.	11,000
	Access Floor	1	Job	L.S.	8,000
	Hardware	1	Job	L.S.	2,000
	Fuel Tanks & Oil Supply System	1	Job	L.S.	13,000
	Matls. Handling Equipment	1	Job	L.S.	45,000
	Plumbing	1	Job	L.S.	39,000
	Heat., Vent., & A.C.	1	Job	L.S.	93,000
	Electrical	1	Job	L.S.	550,000
	Pump. Sta. Equip. Test	1	Job	L.S.	380,000
	Supervision of Conn. & Interconn. of Equip.	1	Job	L.S.	39,000
	Pump Test	1	Job	L.S.	24,000
	Pumps (1,400 cfs)	6	Job	L.S.	2,850,000
	Sub-Total				$ 9,971,000
	Contingencies				1,029,000
	TOTAL PUMPING STATION				$11,000,000
30.	ENGINEERING AND DESIGN				$ 1,400,000
31.	SUPERVISION & ADMINISTRATION				$ 2,000,000
	TOTAL PROJECT FIRST COSTS				$37,800,000

TABLE B-5

SUMMARY OF CONSTRUCTION EXPENDITURES AND ANNUAL CHARGES

(In $1,000 - 1971 Price Level)

Project Features	RECOMMENDED MULTIPLE PURPOSE PROJECT						ALTERNATIVE TWO PURPOSE PROJECT			ALTERNATIVE SINGLE PURPOSE PROJECT		
	Specific Costs											
	Flood Control	Navigation	Highway Transportation	Joint-Use Costs	Dual Joint-Use Costs	Total Costs	Navigation Highway Trans.	Flood Cont. Highway Trans.	Flood Cont. Navigation	Flood Control	Navigation	Highway Trans.
Lands and Damages	60 (1)			340		400	340	400	400	400	340	160
Relocations				100	7,000(5)	7,100	7,100	7,100	7,100	7,100	7,100	100
Dam				1,600		1,600	2,000	1,700	1,600	1,700	2,000	
Navigation Locks		4,100(3)		9,400		13,500	13,600	8,100	13,500	8,100	13,600	
Bridges (Viaduct)			800(4)			800	900	850				1,500
Pumping Station	8,300 (2)			2,700		11,000		10,700	11,000	10,700		
Engineering & Design	430	210	40	720		1,400	860	1,150	1,400	1,100	800	100
Supervision & Administration	620	310	60	1,010		2,000	1,200	1,500	1,900	1,500	1,060	140
TOTAL PROJECT FIRST COST	9,410	4,620	900	15,870	7,000	37,800	26,000	31,500	36,900	30,600	24,900	2,000
Construction Period (Years)						3.5	3.0	3.0	3.5	3.0	3.0	2.0
Investment & Annual Charges												
Construction Expenditures	9,410	4,620	900	15,870	7,000	37,800	26,000	31,500	36,900	30,600	24,900	2,000
Interest During Construction	535	263	51	903	398	2,150	1,268	1,536	2,093	1,492	1,214	65
Total Investment	9,945	4,883	951	16,773	7,398	39,950	27,268	33,036	38,993	32,092	26,114	2,065
Annual Charges												
Interest & Amortization	337	165	32	568	251	1,353	924	1,119	1,318	1,087	885	70
Operation & Maintenance	20	17	4	13	246	300	241	256	300	252	237	4
Major Replacements	10	4	-	3	-	17	7	13	17	13	6	-
Loss of Productivity on Land	-	-	-	11	-	11	11	11	11	11	11	6
TOTAL ANNUAL CHARGES	367	186	36	595	497	1,681	1,183	1,399	1,646	1,363	1,139	80

Note: Flood control portion of annual charges is based on 100-year economic life; navigation and highway transportation portions are based on 50-year economic life converted to 100-year series.

(1) Removal of part of structure downstream of site - required for flood control only.
(2) Pumping station and equipment including pumps.
(3) Two smaller locks including appurtenant features.
(4) Highway viaduct.
(5) Dual joint-use of sewerage modifications for flood control and navigation.

TABLE B-6

COST ALLOCATIONS

ITEM	FLOOD CONTROL	WATER SUPPLY	NAVIGATION	WATER QUALITY CONTROL	HIGHWAY TRANS PORTATION	RECREATION	TOTAL
A. ALLOCATION OF ANNUAL COSTS=							
**********							
1. BENEFITS	2235000.	0.	484000.	0.	80000.	0.	2799000.
2. ALTERNATE COSTS	1363000.	0.	1139000.	0.	80000.	0.	2582000.
3. BENEFITS LIMITED BY ALTERNATE COST	1363000.	0.	484000.	0.	80000.	0.	1927000.
4. INITIALLY SEPARABLE COSTS	498000.	0.	282000.	0.	35000.	0.	815000.
5. REMAINING BENEFITS BEFORE DUAL COSTS	865000.	0.	202000.	0.	45000.	0.	1112000.
6. REMAINING DUAL BENEFITS	865000.	0.	202000.	0.	0.	0.	1067000.
7. RATIO OF REMAINING DUAL BENEFITS	81.068	0.000	18.932	0.000	0.000	0.000	100.000
8. ALLOCATED DUAL COSTS	402910.	0.	94090.	0.	0.	0.	497000.
9. TOTAL SEPARABLE COSTS	900910.	0.	376890.	0.	35000.	0.	1312000.
10. REMAINING BENEFITS	462090.	0.	107910.	0.	45000.	0.	615000.
11. RATIO OF REMAINING BENEFITS	75.137	0.000	17.546	0.000	7.317	0.000	100.000
12. ALLOCATED RESIDUAL COSTS	277254.	0.	64746.	0.	27000.	0.	369000.
13. TOTAL ALLOCATION	1178164.	0.	440836.	0.	62000.	0.	1681000.
B. ALLOCATION OF LOSS OF PRODUCTIVITY							
**********							
1. SEPARABLE COSTS	0.	0.	0.	0.	0.	0.	0.
2. ALLOCATED JOINT COSTS	8265.	0.	1930.	0.	805.	0.	11000.
3. TOTAL ALLOCATIONS	8265.	0.	1930.	0.	805.	0.	11000.
C. ALLOCATION OF OPERATION + MAINTENANCE							
**********							
1. SEPARABLE COSTS	59000.	0.	44000.	0.	0.	0.	103000.
2. ALLOCATED JOINT COSTS	148019.	0.	34566.	0.	14415.	0.	197000.
3. TOTAL ALLOCATION	207019.	0.	78566.	0.	14415.	0.	300000.
4. SPECIFIC COSTS	20000.	0.	17000.	0.	4000.	0.	41000.
5. ALLOCATED JOINT-USE COSTS	187019.	0.	61566.	0.	10415.	0.	259000.
6. RATIO FOR ALLOC OF JOINT-USE COSTS	72.208	0.000	23.771	0.000	4.021	0.000	100.000
D. ALLOCATION OF MAJOR REPLACEMENTS							
**********							
1. SEPARABLE COSTS	10000.	0.	4000.	0.	0.	0.	14000.
2. ALLOCATED JOINT COSTS	2254.	0.	526.	0.	220.	0.	3000.
3. TOTAL ALLOCATIONS	12254.	0.	4526.	0.	220.	0.	17000.
4. SPECIFIC COSTS	10000.	0.	4000.	0.	0.	0.	14000.
5. ALLOCATED JOINT-USE COSTS	2254.	0.	526.	0.	220.	0.	3000.
E. ALLOCATION OF INVESTMENT + FIRST COST							
**********							
1. ANNUAL INVESTMENT	950626.	0.	355813.	0.	46561.	0.	1353000.
2. ALLOCATED INVESTMENT	28069107.	0.	10506088.	0.	1374805.	0.	39950000.
3. RATIO OF ALLOCATED ANNUAL INVEST. =	70.261	0.000	26.298	0.000	3.441	0.000	100.000
F. ALLOCATION OF CONSTRUCTION EXPENDITURE							
**********							
1. SPECIFIC INVESTMENT	9945000.	0.	4683000.	0.	951000.	0.	15779000.
2. INVESTMENT IN JOINT-USE FACILITIES	18124107.	0.	5623088.	0.	423805.	0.	24171000.
3. INTEREST DURING CONST.JOINT-USE FAC.	975527.	0.	302662.	0.	22811.	0.	1301000.
4. CONST.EXPENDITURE IN JOINT-USE FAC.	17148580.	0.	5320426.	0.	400994.	0.	22870000.
5. RATIO OF CONST.EXP.IN JOINT-USE FAC.	74.983	0.000	23.264	0.000	1.753	0.000	100.000
6. CONST.EXPENDITURE IN SPECIFIC COSTS	9410000.	0.	4620000.	0.	900000.	0.	14930000.
7. TOTAL CONSTRUCTION EXPENDITURES	26558580.	0.	9940426.	0.	1300994.	0.	37800000.
G. SUMMARY							
**********							
1. TOTAL CONST.EXPENDITURES (ROUNDED)	26560000.	0.	9940000.	0.	1300000.	0.	37800000.
2. ANNUAL COSTS	1178164.	0.	440836.	0.	62000.	0.	1681000.
3. ANNUAL BENEFITS =	2235000.	0.	484000.	0.	80000.	0.	2799000.
4. BENEFIT/COST RATIO =	1.90	0.00	1.10	0.00	1.29	0.00	1.67

9,940
4,970

APPENDIX C

FISH AND WILDLIFE REPORT

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
U. S. POST OFFICE AND COURTHOUSE
BOSTON, MASSACHUSETTS 02109

September 20, 1971

Division Engineer
New England Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This is our report on the proposed Charles River Dam to be located in Boston, Suffolk County, Massachusetts, as authorized by the Flood Control Act of 1968. This report was prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-666 inc.), in cooperation with the Massachusetts Division of Marine Fisheries and Division of Fisheries and Game and the National Marine Fisheries Service. It has their concurrence as indicated in letters dated May 26, June 4, and May 19, 1971, respectively.

The project will consist of a dam, navigation locks, pumping station, fish passage facilities, and appurtenant works at river mile 00.76 between Boston and Charlestown in the vicinity of Warren Avenue. The purposes of the project are flood control, navigation, and highway transportation. Pollution abatement benefits will be realized through operation of locks and sluices which will substantially reduce salt water intrusion upstream.

The dam will replace the functions of the existing Charles River Dam located about 2,250 feet upstream from the project site. The pool held by the existing dam is known as the Charles River Basin. It has a normal surface elevation of 2.38 feet above mean sea level, and a surface area of about 675 acres extending upstream almost to the Watertown Dam at river mile 09.77. The sluice and lock gates at the existing dam will remain open or be removed after the new dam is constructed.

The new earth fill dam will be constructed with three navigation locks, a pumping station, and a highway crossing over the entire structure. The top elevation of the dam will be 12.4 feet above mean sea level and 35 feet above the river bed. The existing pool level of the Basin will be maintained but it will extend downstream to the new dam adding about 45 acres of surface area. Pool elevations during high run-off periods will be controlled by operation of the pumping station which has an 8,400 cfs pumping capacity.

Downstream from the new dam tides normally range from 4.6 feet below to 4.9 feet above mean sea level. As a result downstream water levels will be above the normal pool elevation of the Charles River Basin for about 5 hours of every tidal cycle. High spring tides and storm tides reach about 8.6 feet and 10.1 feet, respectively, above mean sea level.

Two low-level sluiceways will be installed to release brackish polluted water from the Basin during lower tidal levels. One combination upper level sluiceway and fish lock will be installed near the surface of the pool to accommodate normal sluicing and anadromous fish.

Two of the navigation locks, each 200 feet long, 25 feet wide, and 8 feet deep at low water, are designed for recreational boating. A third lock 300 feet long, 40 feet wide, and 17 feet deep at low water will accommodate large pleasure craft and commercial vessels.

Fish passage and viewing facilities will be incorporated in the project. A schematic plan of the facilities we recommend are shown on the attached plate. We understand that these facilities are being included in the project plan.

The fish passage facilities and their operation include --

a. A conventional wier type fishway to be operated when the tide level on the downstream side of the dam is at or below Basin level on the upstream side of the dam. This occurs for approximately 7-1/2 hours of every 12-1/2 hour tidal cycle.

b. A combination sluice and fish lock which will provide attraction water for the fishway and be used to pass fish during periods when the tide is above Basin level. This occurs for approximately 5 hours of every tidal cycle.

To provide an attracting flow through the fish lock a 50 cfs capacity pump will be operated. At 30-minute or appropriate intervals, depending upon the numbers of fish entering the lock, the pump will be shut off and the fish crowder screen will be lowered at the downstream end of the lock then moved upstream to force the fish through the opened upstream gate.

c. Railings and walkways will be provided to accommodate public viewing of fish migration through the passage facilities.

d. Both the fishway and fish lock will be utilized for downstream fish passage during June through October and when the tide is at or below the Basin level.

e. It is anticipated that the fish passage facilities will be operated during daylight hours between April 15 and June 15 for upstream migrating fish. At other periods of the year the facilities will be used as a gravity sluice as part of the pool level control function of the dam.

In conjunction with this project non-Federal interests will construct an 8-foot pressure conduit from the new Boston marginal conduit pumping station located near the existing lock and dam through the new dam to prevent sewage release into the pool area between the two dams. New feeder lines will be installed to carry sewage in other existing lines to the marginal conduit pumping station. Relocation of Boston Edison and Metropolitan Bay Transit Authority power cables crossing the river will be required.

We understand that the Metropolitan District Commission will operate the dam and its facilities following project construction and that Charles A. Maguire Associates of Boston has been engaged as consultants for project planning.

The project will have no significant effect upon wildlife resources.

The Charles River formerly supported large runs of anadromous fish. American shad, alewife, and blueback herring were well represented in the runs. Lesser numbers of other species including American smelt also entered the river. These runs were practically eliminated by dams

and pollution which accompanied the growth and development of metropolitan Boston.

Today, only a small remnant of the original anadromous fish runs remain. Numbers of alewife and American smelt take advantage of occasional lock operations at the Charles River Dam and manage to enter the Charles River Basin but can move upstream only to the Watertown Dam. Upstream movement stops at this dam because of an inefficient fishway.

Fish habitat in the Charles River Basin is marginal. Salt water entering the Basin through the locks, coupled with industrial and urban pollutants, create a wedge of practically septic water lying about 10 feet below the surface.

Since the Charles River Basin is partly brackish, the fish population includes representatives of freshwater and saltwater species. Saltwater species such as the striped bass and white perch occasionally enter the Basin, but this is not a spawning run. Freshwater species include white catfish, brown bullhead, yellow perch, black crappie, and common sunfish. Fish populations are low and fishing pressure for these species is very light due to pollution.

There is no commercial fishing for anadromous species.

The Massachusetts Division of Marine Fisheries, in cooperation with the Massachusetts Division of Fisheries and Game, Metropolitan District Commission, U. S. Army Corps of Engineers, National Marine Fisheries Service, and the Bureau of Sport Fisheries and Wildlife, has an active program for the restoration of anadromous fish to the Charles River.

At the present time, the program is designed primarily for restoring American shad to the river. However, runs of other anadromous species such as alewife and blueback herring will be increased. Primary requirements for restoration are installation of efficient fish passage facilities at up to 11 dams, including the subject project, and abatement of pollution, and initiation of shad runs. The Massachusetts Division of Marine Fisheries plans to stock eggs of the American shad in the Charles River this year (1971) if a sufficient supply of eggs is available.

The pollution abatement functions of the proposed plan are expected to improve fish habitat and sport fishing in the Charles River Basin.

Installation of efficient fish passage facilities at the proposed project is vital to anadromous fish restoration in the Charles River since the new dam will be at the river mouth. Fish passage needs to occur without delay in the spring so spawning adults can reach upstream spawning areas before rising water temperature and reduced dissolved oxygen create undesirable conditions.

Investigations reveal that shad restoration to 60 miles of the 80-mile long river is a practical goal. There exists at least 12,540 100-square yard units of spawning habitat in the 60-mile reach. Nursery habitat for young fish also appears to be adequate. Eleven fish passage facilities, adequate for passage of American shad, are needed. Facilities for the subject project are now being included in project plans. Reconstruction of the fishway at the Watertown Dam, to make it suitable for shad passage, is expected in 1972. The existing fishway at the South Natick Dam needs to be reconstructed to pass shad. Fishway construction will be planned at dams in their upstream order and construction is expected to extend over a 15-year period.

The numbers of fish in annual spawning runs, as shown in Table 1, are expected to range from 28,800 to 37,600 when the run is fully restored. Because of time needed to plan and construct fish passage facilities and increase fish numbers through natural reproduction expected numbers should average from 28,800 to 34,300 fish (table 2). The average annual harvest would range from 4,300 to 6,900 fish. Allocating each fisherman one fish per day results in fisherman effort ranging from 4,300 to 6,900 fisherman days per year valued at $25,800 to $41,400. No commercial fishing for shad is expected in the Charles River.

The higher number of fish anticipated is used in table 1 to determine the expected maximum number of fish to be passed at each dam. This helps to assure that fish passage facilities are constructed with adequate capacity.

The fishway operations are expected to attract considerable public interest. Visitor viewing facilities will be provided at the Charles River Dam and are expected to attract at least 8,900 visitors per year with a valuation of $4,450.

Table 1. Potential Shad Fishery, Charles River, Massachusetts.

Stream segment	Stream miles	Habitat/ 100 sq.yd. units 1/	Adult shad returning @ 3.0/unit	Harvest @ 20%	Man-days @ 1.0 fish/day	Value @ $6 per
#1 Proposed Charles River Dam to Watertown Dam	9.01	475	1,425	285	285	1,71(
#2 Watertown Dam to Rolling Stone Dam	0.96	648	1,944	389	389	2,33(
#3 Rolling Stone Dam to Bleachery Dam	1.08	334	1,002	200	200	1,20(
#4 Bleachery Dam to Moody Street Dam	0.81	329	987	197	197	1,18(
#5 Moody Street Dam to Newton Lower Falls Dam	5.33	1,284	3,852	770	770	4,62(
#6 Newton Lower Falls Dam to Cordingly Dam	0.29	0	0	0	0	(
#7 Cordingly Dam to Metropolitan Circular Dam	1.77	880	2,640	528	528	3,16(
#8 Metropolitan Circular Dam to Silk Mill Dam	0.20	0	0	0	0	(
#9 Silk Mill Dam to Cochrane Dam	14.32	2,675	8,025	1,605	1,605	9,63(
#10 Cochrane Dam to South Natick Dam	6.61	2,465	7,395	1,479	1,479	8,87(
#11 South Natick Dam to Medway Dam	19.72	3,450	10,350	2,070	2,070	12,42(
	60.10	12,540	37,620	7,523	7,523	$45,13
Minimum Estimate Massachusetts Division of Marine Fisheries		12,540	@2.3/Unit 28,842	@15% 4,326	4,326	$25,95

1/ Habitat/100 sq.yds. was developed by Department of Natural Resources, Division of Marine Fisheries.

Table 2. Weighted Average Annual Shad Numbers, Utilization and Value.

Project year 1-5, 1975-1980

Fishways installed at Dams #1, #2, #3, and #4.

$\frac{5,358 \text{ potential shad} \times 5 \text{ years}}{2}$ = 13,395 shad

Project year 6-15, 1981-1990

Fishways installed at remaining dams.

$\frac{32,262 \text{ potential shad} \times 10 \text{ years}}{2}$ = 161,310 shad plus

53,580 shad (5,358 shad x 10 years) = 214,890 shad

Project year 16-100, 1991-2075

Fishways completed and run restored to potential.

37,620 shad x 85 years = 3,197,700 shad + 214,890 + 13,395 = 3,425,985 shad

$\frac{3,425,985 \text{ shad}}{100 \text{ years}}$ = 34,259.85 (34,300) shad average annual

34,300 shad per year x .20 (catch rate) = 6,860 (6,900) shad harvest

= 6,900 man-days(@ 1 fish/man-day) x $6.00/man-day = $41,400 average annual value

Providing visitor viewing facilities at other dams in the river has been considered. Problems of physical layout, public safety, vandalism, and the cost of attendants at the fishways, however, are such that the least expensive fishway designs call for gratings or fences to protect the fishways. Nevertheless, visitors are expected to assemble at many of the dams during the fish runs. The potential visits expected annually are estimated at at least 29,600 visitor-days with a value of $14,800.

American smelt will continue to enter the Charles River Basin as they do now. It is not likely, however, that they will pass the fishway at the Watertown Dam. Increases in smelt fishing opportunities will occur primarily through pollution abatement. The proposed Charles River Dam fish passage facilities, however, will increase smelt numbers in the lower Basin.

Since alewives and blueback herring will use the fishways, their numbers can be expected to increase as a result of fishway construction. No commercial fishing is expected for these species but a minor amount of sport fishing may occur. Their most significant value is as a forage species for marine fish. This value cannot readily be measured in dollars.

The value of an annual run of anadromous fish in the Charles River cannot be measured in dollars alone. In view of the rising public interest in the environment, restoration of anadromous fish to the Charles River, from an aesthetic viewpoint alone, is a goal worth achieving. It will provide evidence that man can repair some of the damage caused by pollution, dam building, and industrial growth and it will stimulate public interest in the environment. The Charles River Basin is one of only a few areas where fishing opportunities can be provided for the people of Boston.

Successful restoration of anadromous fish to this historic river will serve to provide additional recreational opportunities as noted in the Metropolitan Area Planning Council's 1969 report, "Open Space and Recreation Program for Metropolitan Boston, Volume 3, The Mystic, Charles and Neponset Rivers." Development of such recreational opportunities to serve metropolitan areas is currently a subject of national concern and action.

Preliminary cost estimates for fish passage facilities will amount to $870,000 as shown in table 3.

Table 3. Fishway Locations and Estimated (Preliminary) Costs, Charles River, Massachusetts.

	River mile	Height of dam (feet)	Potential No. of shad to be passed	Estimated fishway cost $	
#1 Proposed Charles River Dam	00.76	tidal	37,620	242,000	
#2 Watertown Dam	09.77	6	36,195	44,000	
#3 Rolling Stone Dam	10.73	out	34,251	0	
#4 Bleachery Dam	11.81	20"	33,249	3,000	
#5 Moody Street Dam	12.62	14	32,262	132,000	
#6 Newton Lower Falls Dam	17.95	6	28,410	44,000	
#7 Cordingly Dam	18.24	13	28,410	10,000	(channel improvement)
#8 Metropolitan Circular Dam	20.01	20	25,770	142,000	
#9 Silk Mill Dam	20.21	22	25,770	180,000	
#10 Cochrane Dam	34.53	8	17,745	58,000	
#11 South Natick Dam	41.14	5	10,350	58,000	
#12 Medway Dam	60.86	-	none	0	
				$913,000	

The Metropolitan Area Planning Council report also indicates a need for zoning or other control of recreational activities in the Charles River Basin. The Basin is intensively used for recreational power boating, sailing, and sculling. Intensive use, especially by power boats, can interfere with sport fishing. We agree that zoning will probably be necessary if the various opportunities are to be fully realized, especially during the summer when recreation activities reach a peak.

We appreciate your cooperation in incorporating fish passage facilities in the Charles River Dam project and we expect that the interagency cooperation evidenced during the design of this project will continue.

Sincerely yours,

Richard E. Griffith

Regional Director

The Commonwealth of Massachusetts
Department of Natural Resources
Division of Marine Fisheries
State Office Building, Government Center
100 Cambridge Street, Boston 02202

Don

May 26, 1971

Donald Reese
Asst. Regional Director
Fish and Wildlife Service
Bureau of Sport Fisheries
and Wildlife
U.S. Post Office and Courthouse
Boston, Massachusetts 02109

Dear Don:

Thank you for your letter of May 13th, 1971 regarding the review draft of the report on the proposed Charles River Dam to be located in Boston, Suffolk County, Massachusetts.

Please be advised that we have reviewed the draft report and that we concur with the statements made regarding anadromous fish and fish passage facilities. However, I request that a citation be included indicating that data listed in Table 1 under the column headed "Habitat/100 sq. yd. units" were developed by the Division of Marine Fisheries under Anadromous Fish Act Project No. AFCS-9.

NB

Sincerely,

Frank Grice
Director

And all the time, we thought Bob Jones knew it. RAS

RECEIVED
MAY 27 1971

AEP:bh

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
14 Elm Street - Gloucester, Ma. 01930

Date: May 19, 1971

Reply to Attn of: FF3

Subject: Proposed Project on Charles River Dam, Suffolk County, Boston, Massachusetts

To: Regional Director, BSFW
Boston, Massachusetts 02109

We have reviewed your comments on the subject project and associated upstream works designed to assist in restoration of anadromous fish runs to the Charles River. Although we have not been actively associated with this particular project, it appears that we can concur with your comments, estimates, and recommendations.

Russell T. Norris
Regional Director

The Commonwealth of Massachusetts
Division of Fisheries and Game
Leverett Saltonstall Building, Government Center
100 Cambridge Street, Boston 02202

JAMES M. SHEPARD
DIRECTOR

River Basin Studies
1 Reg. Supvr. [illegible]
Asso. Reg. Supvr.
2 Corps Projects
Special Studies (C) (1)
NARWRS (W) (D)
Mgmt. Asst.
Clerk-Steno (1) (2)
3 Files

June 4, 1971

Mr. Donald Reese
Assistant Regional Director
U.S. Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
U.S. Post Office and Courthouse
Boston, Massachusetts 02109

Dear Mr. Reese:

This letter responds to your request for our comments relative to the review draft on the proposed Charles River Dam to be located in Boston, Suffolk County, Massachusetts.

Please be advised that the Division of Fisheries and Game concurs with the aforementioned report.

We appreciate the opportunity to review and comment on this project report.

Very truly yours

Arthur W. Neill

Arthur W. Neill
State Ornithologist

AWN/cms

RECEIVED
JUN 8 1971

APPENDIX D

COMMONWEALTH OF MASSACHUSETTS

WATER QUALITY STANDARDS

COMMONWEALTH OF MASSACHUSETTS

WATER RESOURCES COMMISSION

DIVISION OF WATER POLLUTION CONTROL

WATER QUALITY STANDARDS

Adopted by the Massachusetts Division of Water Pollution Control on March 3, 1967, in accordance with the Provisions of Section 27 (4) of Chapter 21 of the General Laws, and in accordance with the procedure required by Chapter 30A of the General Laws, and after a public hearing held on February 17, 1967.

Filed with Secretary
of State on
March 6, 1967

Class C

Suitable for recreational boating; habitat for wildlife and common food and game fishes indigenous to the region; certain industrial cooling and process uses; under some conditions acceptable for public water supply with appropriate treatment. Suitable for irrigation of crops used for consumption after cooking. Good aesthetic value.

Standards of Quality

Item	Water Quality Criteria
1. Dissolved oxygen	Not less than 5 mg/l during at least 16 hours of any 24-hour period nor less than 3 mg/l at any time. For seasonal cold water fisheries at least 5 mg/l must be maintained.
2. Sludge deposits-solid refuse-floating solids-oils-grease-scum.	None allowable except those amounts that may result from the discharge from waste treatment facilities providing appropriate treatment.
3. Color and turbidity	None allowable in such concentrations that would impair any usages specifically assigned to this class.
4. Coliform bacteria	None in such concentrations that would impair any usages specifically assigned to this class.
5. Taste and odor	None in such concentrations that would impair any usages specifically assigned to this class, and none that would cause taste and odor to edible fish.
6. p^H	6.0 - 8.5

7.	Allowable temperature increase	None except where the increase will not exceed the recommended limits on the most sensitive receiving water use and in no case exceed 83°F in warm water fisheries and 68°F in cold water fisheries, or in any case raise the normal temperature of the receiving water more than 4°F.
8.	Chemical constituents	None in concentrations or combinations which would be harmful or offensive to human, or harmful to animal or aquatic life or any water use specifically assigned to this class.
9.	Radioactivity	None in concentrations or combinations which would be harmful to human, animal, or aquatic life for the appropriate water use. None in such concentrations which would result in radionuclide concentrations in aquatic life which exceed the recommended limits for consumption by humans.
10.	Total phosphate	Not to exceed an average of 0.05 mg/l as P during any monthly sampling period.
11.	Ammonia	Not to exceed an average of 1.0 mg/l as N during any monthly sampling period.
12.	Phenols	Not to exceed an average of 0.002 mg/l at any time.

Class SC

Suitable for aesthetic enjoyment; for recreational boating; habitat for wildlife and common food and game fishes indigenous to the region; industrial cooling and process uses.

Standards of Quality

Item	Water Quality Criteria
1. Dissolved oxygen	Not less than 5 mg/l during at least 16 hours of any 24-hour period nor less than 3 mg/l at any time.
2. Sludge deposits-solid refuse-floating solids-oils-grease-scum	None except that amount that may result from the discharge from a waste treatment facility providing appropriate treatment.
3. Color and turbidity	None in such concentrations that would impair any usages specifically assigned to this class.
4. Coliform bacteria	None in such concentrations that would impair any usages specifically assigned to this class.
5. Taste and odor	None in such concentrations that would impair any usages specifically assigned to this class and none that would cause taste and odor in edible fish or shellfish.
6. pH	6.5 - 8.5
7. Allowable temperature increase	None except where the increase will not exceed the recommended limits on the most sensitive water use.

8.	Chemical constituents	None in concentrations or combinations which would be harmful to human, animal or aquatic life or which would make the waters unsafe or unsuitable for fish or shellfish or their propagation, impair the palatibility of same, or impair the water for any other usage.
9.	Radioactivity	None in such concentrations which would be harmful to human, animal or aquatic life for the designated water use. None in such concentrations which would result in radio-nuclide concentrations in aquatic life which exceed the recommended limits for consumption by humans.
10.	Total phosphate	Not to exceed an average of 0.07 mg/l as P during any monthly sampling period.
11.	Ammonia	Not to exceed an average of 1.0 mg/l as N during any monthly sampling period.

Notes:

1. Coastal and marine waters are those subject to the rise and fall of the tide.

2. Appropriate treatment is defined as the degree of treatment with disinfection required for the receiving waters to meet their assigned state or interstate classification and to meet the objectives of the water quality standards. Disinfection from October 1 to May 1 may be discontinued at the discretion of the Division of Water Pollution Control.

3. The water quality standards do not apply to conditions brought about by natural causes.

4. The waters shall be substantially free of pollutants that will:

   (1) unduly affect the composition of bottom fauna

   (2) unduly affect the physical or chemical nature of the bottom

   (3) interfere with the spawning of fish or their eggs

5. The standards shall apply at all times in coastal and marine waters.

6. The amount of disinfection required shall be equivalent to a free and combined chlorine residual of at least 1.0 mg/l after 15 minutes contact time during peak hourly flow or maximum rate of pumpage.

Approved by Commissioner of Public Health

Date: 3/3/67

Alfred L. Frechette

Dr. Alfred L. Frechette

Approved by Division of Water Pollution Control

Date: 3/3/67

Thomas C. McMahon

Thomas C. McMahon
Director

A TRUE COPY ATTEST:

Rose Stern

Notary Public

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY	CK. BY

SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, TECH. ENG. BRANCH
REVIEWED:
PROJECT ENGINEER
APPROVAL RECOMMENDED:
CHIEF, BRANCH

WATER RESOURCES DEVELOPMENT PROJECT

CHARLES RIVER LOCKS AND DAM

PROJECT PLAN

CHARLES RIVER BASIN — MASSACHUSETTS

APPROVED — DATE

CHIEF, ENGINEERING DIVISION

SCALE: | SPEC NO.

DRAWING NUMBER

SHEET

PLATE 2-3